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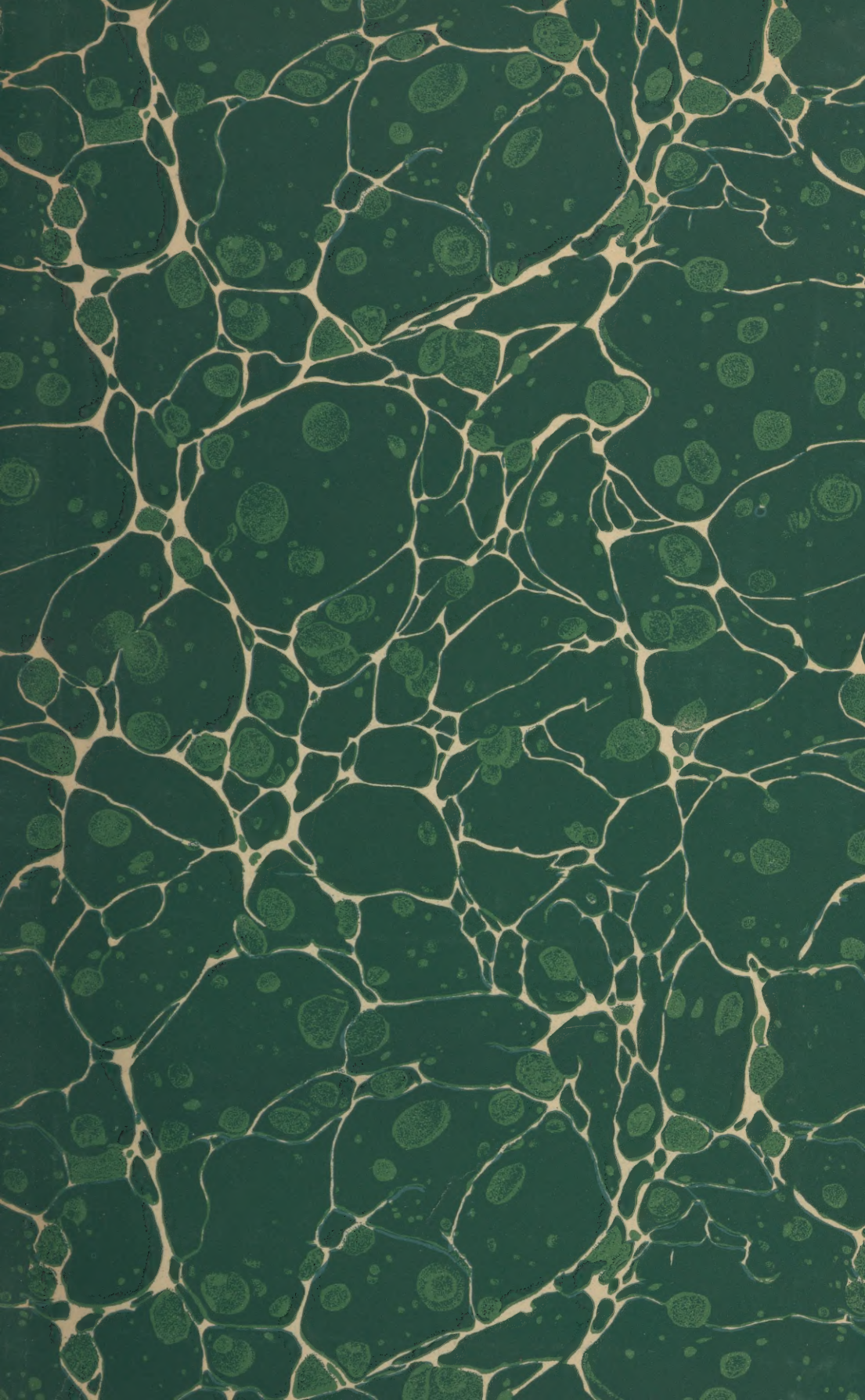
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HERNIA

ITS ANATOMY, ETIOLOGY, SYMPTOMS, DIAGNOSIS,
DIFFERENTIAL DIAGNOSIS, PROGNOSIS,
AND OPERATIVE TREATMENT

BY

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TWO HUNDRED AND THIRTY-TWO
ORIGINAL ILLUSTRATIONS

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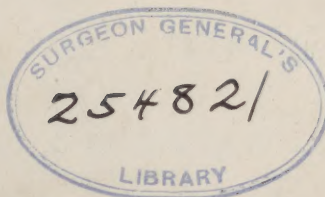
W. C. SHEPARD



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TO
D. L. W.

PREFACE

The object of this book is to present within reasonable space the most important features of the anatomy, etiology, symptoms, diagnosis, differential diagnosis and prognosis of hernia, together with the best operative technic of modern surgeons.

A brief historical sketch has been incorporated in the more important chapters. More space has been devoted to the anatomy than is usual in works on hernia, in order to have the material accessible, and to render unnecessary a search through the more exhaustive treatises devoted exclusively to anatomy.

During the preparation of this volume every source of information has been studiously sought, and a great amount of literature has been accumulated. To consult all of this has been no small undertaking, but thanks to the facilities afforded by the John Crerar Library, where almost all of the reference work has been done, this task has been rendered comparatively easy.

The operations for hernia are legion and it is impossible to give all of them in a one volume book, consequently some good ones have been omitted. The author has adhered to the plan of giving in detail the technic of the operation he uses for each variety of hernia. Other methods that are less generally used, but invaluable in certain cases, are outlined briefly.

The bibliography has been selected very carefully and with the hope that the original articles will be consulted; a majority of these contain exhaustive bibliographies.

In order to avoid repetition and save space, cross references have been used freely and the reader is urged to consult the index.

All of the drawings have been made especially for this work by Mr. W. C. Shepard, whose painstaking efforts and hearty coöperation have made it possible to present the subject from a new point of view, and also to combine the anatomical details with the operative technic in the same drawings, thus greatly increasing their value.

The author takes pleasure in acknowledging his obligation to the many physicians at home and abroad who have been most kind in answering letters of inquiry.

His thanks are also due to Dr. W. W. Watkins, for advice on roentgen ray technic; to Mr. Robert J. Folonie and to Mr. Hendrik Folonie for suggestions on the medico-legal chapter; to Dr. L. J. Mitchell and Mr. William Whitford for editorial suggestions; to Miss May Whitford for her excellent

work in typing the manuscript; to Mr. W. A. Brennan and Miss Florence Carpenter for assistance in translating; to the members of the staff of the Surgeon-General's Library for their many kindnesses; to the entire personnel of the John Crerar Library, and especially to Mr. J. C. Bay and Miss Ella Salmonsens for their many helpful suggestions and courtesies; and to the publishers for their cheerful cooperation during the four years that the book has been in preparation.

LEIGH F. WATSON.

CHICAGO, ILL.

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HERNIA

HISTORICAL INTRODUCTION

“No great and perfect work is ever accomplished at a single effort, or receives its final polish from one instrument.” (Galen.)

We are, most of us, busy practitioners, and I often wonder whether we are mindful of what has been accomplished by our predecessors, and if we sometimes pause at the historical mile-posts established by those who have labored so diligently and accomplished so much under difficulties of which we have no conception.

Hernia is undoubtedly as old as the history of man, and while no records are extant, it was probably treated by primitive man with the simple measures at hand, guided by his instinct. As civilization and knowledge increased, reducible hernia was retained by a bandage or girdle, and strangulated hernia was treated by such palliative measures as a light diet, rest, purgation, and the application of cool water, which was known to be more efficacious than warm water. Massage was known, and taxis was employed, being seldom gentle. Reduction was often aided by partially inverting the patient—our modern Trendelenburg position.

Operation was never attempted for strangulated hernia as its causation was not understood. Astringent plasters were applied, bleeding was practiced, and wounds were sutured or bandaged to hasten healing. Trephining of the skull was done in the early stone age. In primitive times knives were made of flint and they were used up into historic times by the Egyptians and the Jews. Surgery was veiled in mysticism and sorcery. If a patient lived, the good spirit had triumphed; if he died, the evil demon was the stronger.

The earliest historic records of surgery begin with the Sumerians in Mesopotamia (about 4000 B.C.), who were conquered in turn by the Semites, Babylonians and Assyrians, with the result that each added something, real or fanciful, to the development of medicine. Diseases were classified according to symptoms. The blood was believed to be the foundation of life; the arterial blood was called “day” blood and the venous blood was called “night” blood.

Colic and abdominal pain were ascribed to phlegm, bile, and wind. Herbs, honey and date syrup were mixed with milk and water and used internally, and also externally as salves. Cupping, oil rubbing, hot baths and cold applications were used. However, any treatment was supposed to

be ineffective unless combined with mystic incantations, and the application of various amulets and charms to help drive out the evil spirit. Medicine and surgery were controlled by the temple priests who were the only practitioners.

The Babylonians were well versed in astronomy, consequently the various anatomical regions were placed under the control of the signs of the Zodiac, and prognosis was made from astrology. The number 7 was considered unlucky and patients were not treated on any day that could be divided by 7.

The earliest records of physicians' fees and the regulation of the practice of surgery is found in the Code of Hammurabi (2200 B.C.) in which it is stated: "If a physician cause a severe operating wound with a bronze operating knife and cure the patient, or if he open a tumor and save his eye, he shall have ten shekels of silver." However, if the patient died, the physician had his hands cut off. It might be mentioned that the bronze knives of this ancient period would take an edge equal to the best steel.

When a person was ill, the custom of the Babylonians was to lay him in the public square where the passers-by could talk to him, and if they had ever had his disease or knew of any one who had suffered from it, they were to give him advice as to what to do. No one was allowed to pass the sick man without asking him about his ailment (Herodotus).

The medical and surgical history of ancient Egypt goes back to the time of the pyramids, about 3000 B.C. As Neuburger remarks: "Thanks to the labors of the past century, thanks to the desert sand and the almost rainless climate of Egypt, which greatly assist to preserve the hoary remains of a past civilization, we are far better able to review its development than in the case of less remote Greece and Rome." The art of medicine and surgery in Egypt reached its zenith about 2000 B.C. The Egyptians made improvements in the surgery of the Babylonians. They used bronze operating knives, forceps, hooks and needles; they tied true reef knots, opened abscesses and packed the cavities with lint, linen or cotton. They improved the bandage treatment of hernia and discovered enemas. The Egyptians excelled all the races of antiquity in hygiene.

The priests were the only physicians, and medicine was taught in the temple schools. Toward the period of decline, specialism appeared. There were those who treated abdominal diseases, and others who treated affections of the head and teeth. Before extracting decayed teeth, they filled them with lead so they would not break. They believed that strangulation of hernia was due to an accumulation of hardened feces. This was also the belief of the Jews, and it is referred to in the Old Testament. This opinion was held later by Celsus and by most surgeons after him; it was not until the 17th century that Lavater finally dispelled it in his book, "*De enteroparistole*."

Most of our knowledge of the medicine and surgery of ancient Egypt is derived from the Ebers and Brugsch papyri, which were written between

the 16th and 14th centuries, B.C. At the time of the arrival of the first Greek travelers in 700 B.C., Egyptian medicine and surgery had begun its decline. Dissection was allowed at Alexandria under the Ptolemies, but after the Roman invasion it was abandoned because the Romans believed that contact with a corpse was profanation. The Alexandrian Library was founded by Alexander the Great in 320 B.C. It was destined to be the principal medical center for one thousand years, and contained 500,000 volumes when it was burned the first time. Mark Antony restored it at the behest of Cleopatra by moving the library from Pergamos, and so it remained undisturbed until finally destroyed in 640 A.D.

The Greeks, ancient patrons of the arts and sciences, contributed to the improvement of surgery and excelled in diagnosis. Apollo and his son Æsculapius were celebrated as surgeons and were reckoned among the gods. Podalirius and Machaon, sons of Æsculapius, as well as Chiron the Centaur, were also noted surgeons of ancient Greece, but unfortunately the monuments and writings of those ages were long ago entirely effaced by the ravages of the elements and time. Hippocrates, who was a descendant of Æsculapius and lived in the 4th century B.C., excelled all others in the study of medicine and surgery. He collected the available knowledge of the time on disease and its treatment, and added his own valuable commentaries. In his writings, as well as in the fragments left by his contemporaries, Praxagoras of Cos and Cœlius Aurelianus, there are references to hernia. Praxagoras is credited with practicing taxis for strangulated hernia.

The progress of the Grecian surgeons stimulated the interest of the Egyptians and Romans. Later, in Greece, Philoxenus, Gorgonus, Sostratus, Herones, the two Appollonii and Ammonius Alexandrinus; and in Rome, Tryphon, Euelpistus and Meges were famous surgeons, but their works are all lost. We know of them only through the writings of Celsus. The Romans never equaled the Greeks in medicine or surgery. To Asclepiades, who lived in the 2nd century B.C., is due mainly the credit of bringing Greek medicine and surgery to Rome.

The surgery of the ancients has come down to us especially in the writings of the famous Roman, Celsus, who lived in the 1st century A.D. He operated extensively on umbilical hernias, and less frequently on the inguinal variety. He described the translucency of hydroceles, used ligatures for hemorrhages, sutured wounds of the intestines, and advised the inclusion of the peritoneum in closing the abdomen. For inoperable nonstrangulated hernias he used the ancient *emplastrum contra rupturam* and kept the patient in bed for forty days. His directions for bandaging umbilical hernia in children differ only slightly from the present-day methods. (See chapter on umbilical hernia.) He described and practiced both ligation and excision of hernial sacs, with suture of the opening. He applied compression accompanied sometimes by astringents.

Areteus, a Greek physician of the 1st century, wrote on hernia, his

methods of treatment being similar to those of Celsus. Soranus of Ephesus, who lived in the 1st and 2nd centuries A.D., was the most famous obstetrician and gynecologist of antiquity, and was the first to describe hernia of the ovary and tube.

In passing, it is interesting to note that another Roman of this time, Vitruvius Pollo, described the symptoms of lead poisoning from leaden aqueduct pipes, and also wrote that goiter was due to the water in certain localities.

Galen, the last of the famous Greek surgeons, lived in the 2nd century A.D. He studied in Alexandria and afterwards went to Rome. He was an ardent vivisector and studied anatomy in monkeys. Because the tunica vaginalis is open in these animals, he thought it was open in man, and on this account was led into the error of believing that hernia was due to a rupture of the peritoneum. He described nearly every bone in the body. Dissections were generally abandoned after the time of Galen, who represented the zenith of the surgery of antiquity, and by the 3rd century surgery began to decline. Galen's method of treating hernia was generally by ligating the sac at the superficial ring or below it. His belief that hernia was due to a peritoneal rupture was held by many, well down into the Christian Era; however, it was the opinion of Paulus Ægineta and those who followed him, that hernias of slow formation were due to stretching of the peritoneum, and that it was only in a sudden hernia that the peritoneum ruptured. Rhazes, Lanfranc, and Guy de Chauliac, who came later, apparently knew that in hernia there was no peritoneal rupture; but the point was not fully established until proved by Ruysch's dissections at the end of the 17th century.

Oribasius, a famous Greek physician of the 4th century, studied in Alexandria, later becoming physician to the Emperor Julian. His encyclopedia on medicine and surgery is one of the most complete that has survived. Aëtius, a Greek physician of the 5th century, wrote on surgery, but like others of this decadent period his books were only a compilation of the works of the earlier Greek writers. He treated hernia by compression and astringents.

Paulus Ægineta, a Greek physician and surgeon, who practiced in Alexandria in the first half of the 7th century, the time of the Arabic invasion, represents the last of a long line of famous physicians and surgeons of this school of learning, which existed for nearly 1000 years. Paulus wrote at length on surgery and his writings on hernia are quite extensive. He dwelt on the symptoms of hernia, and indications for treatment, especially by the use of the ligature. He operated for nonstrangulated hernia, according to the method of Celsus, often using the transverse abdominal incision.

During the tumultuous times of the 5th century, when the ominous clouds of the Dark Ages cast their pall over all Europe, and proud Rome, suffering the common calamity, fell before the northern barbarians, medicine and surgery, which had been under the influence of Grecian culture, were compelled to seek refuge in the monasteries; and the priests, again, as in

ancient times, became the physicians, a condition that continued until the 16th century when medicine was finally separated from the church.

About 500 A.D. the Persians gave asylum to Greek knowledge, and in turn passed it on to the conquering Arabs. The Arabic period began with the second destruction of the Alexandrian school in 640 by Omar, the successor of Mahomet.

After their first fanaticism had spent itself, the Arabs acquired a thirst for knowledge from their contact with civilization, and they became ardent patrons of the arts and sciences. They translated nearly all of the extant medical literature of Greece into Arabic. Indeed it is to these translations that we have had to turn to supply us with some of the missing books of Hippocrates, and other ancient works. Among the famous Arabian surgeons may be mentioned Rhazes (850-932) who described the suturing of wounds with the strings of a harp (catgut); Haly Abbas (994) who operated extensively for hernia; Avicenna (980-1037) who described the differential diagnosis of enterocele and omentocele by auscultation; and Albucasis (1122) who closely followed the methods of Celsus. Terapion, Avicenna and Albucasis treated hernia by cauterization after exposing the sac by incision.

The Arabian decline came in the west with the fall of Cordova (1236) before the attack of Ferdinand III of Castile, and in the east with the Mongol invasion and fall of Bagdad (1258). In the 11th century with the decadence of Arabian medicine the leadership passed to the tireless progressive races of Europe. During the 12th and 13th centuries governments became more stable. The dark clouds that had overshadowed all the sciences and kept medical and surgical knowledge at a standstill for nearly a thousand years, gradually began to clear. Schools were established in different countries and medical teaching was actively revived. The school of Salerno was most famous, and the school of Montpellier was next in importance. These institutions reached the height of their influence and power during the 12th and 13th centuries. Other schools sprang up in many cities, notably in Bologna, Padua, Paris, Naples, Toulouse, Valencia, and Oxford.

The most notable hernia surgeons of this time were: Roger of Salerno (1210); Roland (1250); William of Salicet (1230); Theodoric in Bologna; Lanfranc (1315) in Paris, and Guy de Chauliac of Montpellier.

During the 12th and 13th centuries medical science and religion were closely associated. In Italy and France nearly all the surgeons were clerics. Surgery was not recognized as a distinct art by the universities until later, and generally surgical operations were delegated to barbers or hernialists. In this transitional age there were all varieties of charlatans—hernialists, cutters for stone, bleeders, operators for cataract, etc.

Near the end of the transitional age came the master surgeon Guy de Chauliac, in the 14th century. He studied in Montpellier, Paris and Bologna. His great work on surgery was published in 1363. Unlike most surgeons of those days he was not satisfied to turn his work over to barbers and hernial-

ists, but did the operating himself. He was a student of anatomy and was the first to distinguish umbilical from inguinal and femoral hernias. Among the medieval surgeons Guy de Chauliac alone appears to have been aware that hernia may occur in the thigh; after his writings it is not mentioned again until Nicholas LeQuin referred to it in 1665. Guy de Chauliac refers to it in his *Chirurgia Magna*, and in the same work he differentiates ventral from umbilical hernia with which it was previously confused. He revised Celsus' method of laying the hernial sac bare and ligating it. He practiced excision of the sac with suture, which was also advocated by Bertrandi, Lanfranc, and others.

The Age of the Renaissance (14th to 16th centuries), the period of transition between medieval and modern times, marked phenomenal progress in all arts and sciences. In the 16th century decided progress was made in surgery, owing to the gradual lifting of the ban on dissection, and to the separation of medicine from the priesthood which was completed in this century. Among the notable events in the history of hernia are Pol's report of the first case of hernia of the uterus; Fallopius described the fallopian tube; Vesalius described the appendix and Vidus Vidius named it; Plater reported the first case of bladder hernia; Paré described diaphragmatic hernia; Fabricius Hildanus wrote on partial enterocele, and Roussetus described the operation for strangulated hernia, which was later improved and popularized by Pierre Franco. To this period also belongs the "royal stitch," practiced by Fabricius ab Aquapendente and the *punctum aurcum* of Ambroise Paré. These were methods of snaring the hernial sac with wire and separating it from the cord (inguinal hernia) so as to ligate the sac alone. Up to this time there had been no change in the treatment of strangulated hernia for nearly twenty centuries—since the time of Hippocrates—its nature not being understood until the publication of Lavater's work already referred to.

The 17th century found an increased interest in anatomy and surgery. Sennertus reported the second case of hernia of the pregnant uterus; Sala, the second case of bladder hernia; Lavater recorded a case of hernia of the ovary and tube, and described the mechanism of partial enterocele; Ruysch suggested the possibility of hernia of Meckel's diverticulum, and Barbette, Verheyen, Lowe and Seultetus wrote on the different varieties of hernia. Dionis advised dividing the external ring in strangulated hernia. Although operation for strangulation was general at this time, the theories of the ancients as to the cause of strangulation were still prevalent. Lavater's book appeared in 1691. The nonoperative treatment in vogue at this time in Denmark, and in some other countries was to keep the patient in bed for a period of six to twelve months. Many cures were reported following this procedure.

With the 18th century came an awakening in the study of anatomy and surgery, and a final breaking away from the beliefs and practices of the

ancients. Littré and Méry observed cases of hernia of Meckel's diverticulum; the difficulties of diagnosis in diaphragmatic hernia were pointed out by Stehilinus; the duodenal fossae were described by Hensing, Haller and Bordenave; de Garengot described hernia of the appendix and hernia through the linea alba, and Günz, Divoux, Arnaud, and Verdier made extensive studies of bladder hernia. Petit said of large hernias that had long been irreducible, that they "had lost their right of domicile." Gimbernat described the ligament that bears his name, and originated a new and safer operation for strangulated hernia. Mauchart wrote on the anatomy of femoral hernia.

Papen and Smellie observed perineal hernia in women; Le Dran wrote on hernia in the linea semilunaris, partial enterocele and femoral reduction *en masse*; La Chausse described ventral hernia, and De Gouey reported the second case of hernia of the fallopian tube alone. Haller and Verdier reported cases of sciatic hernia of the bladder. Arnaud, Pott, Sharp, Monro, Richter and Camper wrote important treatises on hernia.

The ancients attempted to suture the divided ends of intestine in certain cases of gangrene or accidental rupture; Celsus observed that the best results followed stitching of the large intestine. As early as the 13th century, devices were used to unite the ends of the intestine. The Four Masters employed the trachea of an animal, which was cut the proper length, and inserted it into each end of the divided intestine, and joined the ends of the intestines with sutures. Roger of Salerno and Theodoric used a cannula of elder; Watson made a cannula of fish glue; Scarpa made one from tallow; and Desault and Chopart used a varnished playing card. Randhor invaginated the upper end of the intestine into the lower end, united it with sutures, and returned the intestine to the abdominal cavity; the patient survived. Bichat in the last of the 18th century, pointed out that mucous and serous surfaces do not unite; and Lembert in 1825, described his method of suturing serous surfaces in contact.

With the beginning of the 19th century appeared the classic monographs of Cooper and Scarpa, and the dawn of the modern era in the surgery of hernia.

CHAPTER I

GENERAL CONSIDERATIONS OF HERNIA

A hernia is a protrusion of any viscus or tissue through an abnormal opening in the cavity in which it is normally confined. While this definition applies to various forms of hernia, such as hernia cerebri, hernia of the lung, muscle hernia, hernia of the intestinal mucosa, cystocele, rectocele, etc., the protrusion of an abdominal viscus is so much more common than the extrusion of other viscera, that the unqualified term "hernia," is customarily used to designate hernia of the abdomen.

Etymology.—The etymologic derivation of the word *hernia*, is probably from the Greek word *ἔπρος*, meaning a branch, or offshoot, which simply denotes the hernial projection. The ancients used the Latin word *kele* (Greek *κῆλη*) (a swelling), and combined it with a word which designated the contents of the swelling, such as *enterocele* for intestinal hernia; *epiplocele* for omental hernia; *omphalocele* for umbilical hernia; *cystocele* meaning bladder hernia; while the word *bubonocele* indicated the point of protrusion. The older writers called *enterocele*, *ramex intestinalis*; and *epiplocele*, *hernia zirbalis*. The oldest printed Latin editions of the Bible use the word *herniosus*, and Chaucer, in the 15th century, used the word *hirnia*. The Greek words used to designate the varieties of hernia, strangulation, etc., are discussed at length by Albert.

Rupture.—The term "rupture" is still more generally used by the laity than the word *hernia*, to designate abdominal protrusions. The word *rupture* should be discarded, because it means breaking or tearing through of a protrusion through the muscles due to violence or traumatism. Celsus in the first century A.D., wrote that, "The peritoneum is liable to be ruptured from a blow, from holding in the breath too long or from carrying a great weight, and that, without injury to the integument itself."

We know that hernia is nearly always due to a congenital defect, namely, an open funicular process of peritoneum, or an abnormal size or malformation of a normal opening in the abdominal wall.

A true traumatic hernia or rupture may appear suddenly following injury or violence, such as a fall from a height, or a crushing injury, which causes great increase in intraabdominal tension.

Nomenclature.—Abdominal hernias are designated according to the contents, location, condition and cause:

1. According to the hernial contents, such as hernia of the small intestine, large intestine, omentum, bladder, appendix, ureter, etc.

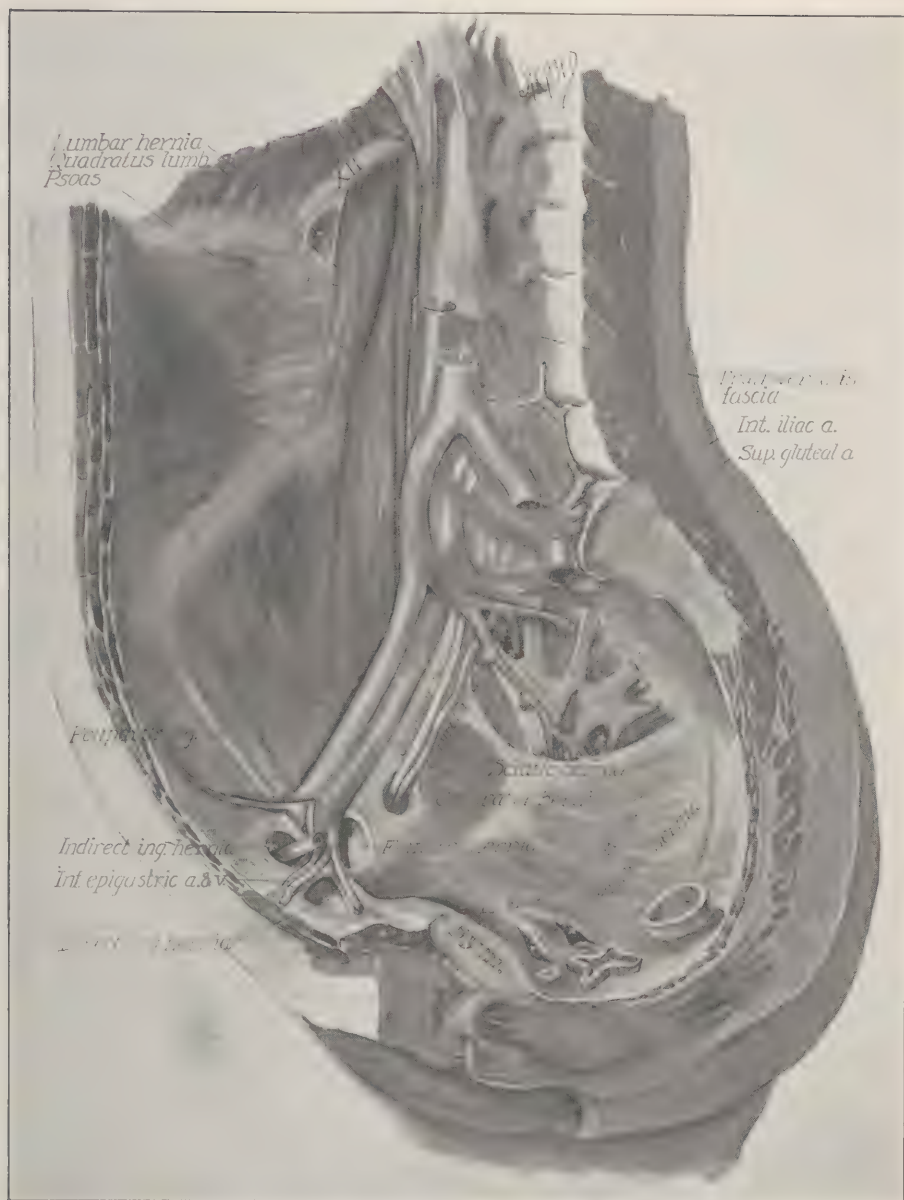


Fig. 1.—The internal openings in the abdominal and pelvic walls.

2. According to their location, namely, inguinal, femoral, umbilical, ventral, diaphragmatic, obturator, perineal, sciatic, etc. (Fig. 1.)

3. According to their condition which is either reducible or irreducible, inflamed, strangulated, gangrenous, etc.

4. According to the cause, which is congenital, acquired, traumatic, post-operative, incisional, etc.

An effort has been made in this monograph to avoid repetition, and for this reason, many subjects are discussed very briefly in the general considerations, because they are of the most importance in certain varieties of hernia, and are dealt with in the chapters on special hernias. For instance, the subject of congenital sacs, which is most closely associated with the etiology of inguinal hernia, will be found in the chapter on inguinal hernia. For all references on any particular subject, the index should be consulted.

ANATOMY

Congenital and Acquired Hernias.—All hernias are divided into two groups, congenital and acquired.

1. Congenital hernia is due to a developmental defect. The sac and contents may be present at birth or the contents may enter a preformed sac after birth. Congenital hernia is usually found in the inguinal region, where a hernia descends into a processus vaginalis testis that has failed to close.

2. In acquired hernia the sac is formed after birth, and the hernia passes through an opening in the muscular wall that closed normally at birth.

Preformed or Congenital Sacs.—Until recently there has been considerable diversity of opinion on the subject of preformed sacs. The older writers usually classified all hernias appearing at birth, as congenital, and those that developed after birth, as acquired. Macready applied the term "congenital," only to the sacs that communicate with the processus vaginalis testis; this plan excludes a large number of inguinal hernias in male children, which are undoubtedly of congenital origin, as well as hernias in the female.

I believe that probably in a great majority of the oblique inguinal hernias in the male, and almost all of those in the female, the sac is preformed, and consists of an open funicular process of peritoneum that was present at birth, even though the hernia did not come down until adult life.

As pointed out by Eccles, the use of the word "congenital," as applied to hernia, relates to the congenital condition of the parts that predispose to hernia, and not to the question of the existence of the hernia at birth.

A man may go through life with an open processus vaginalis, and never develop hernia. In the female a patent canal of Nuck is the usual cause of inguinal hernia.

Russell, Murray, and others claimed that all inguinal (except some of the direct variety) and femoral hernias are congenital. They believed that in infantile hernia, the sac is a perfectly normal funicular process, and that the long prolongation in front of the funicular process is the result of a developmental accident to the tunica vaginalis. (See anatomy of inguinal hernia.) The congenital preformed-sac theory is the best explanation of femoral hernia.

When the sac of oblique inguinal hernia is attached to the spermatic cord and not to the walls of the canal, the hernia is of congenital origin.

Congenital defects in the inguinal region are probably more common than is generally supposed.

Anatomic Factors That Tend to Prevent Hernia.—Nature's methods of preventing the protrusion of viscera into a preformed sac consist of providing an oblique canal and an oblique internal ring, which are protected from the oblique pressure of viscera by an oblique flap of peritoneum.

Varieties of Hernia.—Hernias are usually designated by the name of the anatomic region in which they are situated, namely, inguinal, femoral, umbilical, ventral, diaphragmatic, obturator, lumbar, sciatic, and retroperitoneal or internal.

A very rare case of peritoneal hernia through a cleft in the xiphoid-cartilage was reported by Bramwell. The patient was a man, 36 years old, and of good muscular development. (I have seen a similar case.)

Parts of the Hernia.—As a rule, a hernia consists of three parts:

1. The sac.
2. The contents of the sac.
3. The coverings of the sac and contents.

1. The Sac.—All hernial sacs are divided into three parts:

- a. The mouth, which is the connection between the interior of the sac and the abdomen.
- b. The neck of the sac, which is the narrow constricted portion between the mouth and the body of the sac. In inguinal hernia, the portion of the sac lying within the inguinal canal is called the neck.
- c. The body or fundus of the sac, which is the portion lying beyond the neck. The neck usually lies between the structures of the abdominal wall, and the body or fundus commonly projects beyond the confines of the abdominal wall.

In beginning hernia, the neck often lies in small folds, but as the body increases in size and the hernial contents exert more pressure, it lies smoothly, being limited in size by its retaining walls.

The sac consists of a layer of parietal peritoneum and covers the hernial contents partially or completely. It may be formed before the hernia appears, as in congenital hernia, and remain empty until some unusual increase in intraabdominal tension forces abdominal viscera into it.

In acquired hernia, such as direct inguinal, ventral, and hernia through the linea alba, the sac consists of thinned and stretched parietal peritoneum which has been forced through an opening in the abdominal wall. The relaxation of the parietal peritoneum favors the development of hernia in certain regions. This is especially true in the aged, who rather frequently have hernia of the bladder.

In epigastric hernia, the opening is usually only a small transverse slit, which gradually enlarges into a well-defined hernia following the long-continued pressure by a tongue of omentum.

The hernial sac is often incomplete in sliding hernia of the large intestine, and in certain bladder hernias. In these hernias the sac has a normal appearance on one surface while the other surface is fused with part of the wall of the large intestine or bladder.

Ventral hernias usually have no sac, but are surrounded by thinned out scar tissue and sometimes by parietal peritoneum, limited to the mouth of the false sac. The sac is usually absent in diaphragmatic hernia and in internal hernias.

Size and Shape of the Sac.—The size and shape of the sac depend largely upon the location of the hernia. In oblique inguinal hernia the sac first bulges at the internal ring, usually following an increase in intraabdominal tension caused by a strain, such as a fall, lifting, or any violent exercise. On removal of the tension, the peritoneum quickly resumes its normal shape, but on continued repetition of the strain, the ring gradually relaxes; the peritoneal pouch penetrates deeper into the inguinal canal each time, becoming more stretched and thinned, and finally, it ceases to return into the abdominal cavity and thus forms the beginning of the sac.

If the sac does not pass the external ring, it forms a soft swelling over the inguinal canal, and is known as a bubonocoele. If the hernia passes the external ring, it has a tendency to spread out in the upper part of the scrotum, assuming an oval or oblong shape. Large scrotal hernias sometimes reach to the knees.

Direct inguinal hernias are usually acquired, and are characterized by a small spherical sac and a relatively large hernial opening. They are almost always globular in shape, because of the shortness of the neck of the sac, and they usually remain bubonocoeles.

Umbilical hernia in children appears as a small spherical tumor, when the child cries or strains. As the hernia becomes larger, it assumes a conical form and gradually flattens out the umbilicus. In adults, umbilical hernia first appears as a small oval tumor at the side or upper edge of the umbilical ring. As it increases in size, it assumes a rounded oval form, with a marked tendency to sag downward and to become pendulous. Sometimes these hernias are of enormous proportions, perhaps reaching to the knees.

Ventral hernias do not have any definite shape and do not enlarge as rapidly as umbilical hernias, because they have no true peritoneal sac.

Relation of the Sac to Other Structures.—In oblique inguinal hernia the spermatic cord is always posterior to the sac, and both of these structures are surrounded by thin infundibuliform fascia. The vas deferens lies internal to the spermatic artery in the spermatic cord.

In direct inguinal hernia the sac enters the lower part of the inguinal canal below and internal to the deep epigastric artery. Direct hernias are almost always acquired, and many writers term them ventro-inguinale hernias or hernias through the linea semilunaris.

In direct inguinal hernia the cord is separated from the sac or attached

to it only loosely, while in oblique inguinal hernia, it is usually very adherent to the sac the entire length of the inguinal canal. In oblique inguinal hernia in the female, the round ligament is usually found in front of the sac and quite adherent to it.

Changes in the Sac.—In small recent hernias the internal surface of the sac closely resembles the normal peritoneum of the abdomen. The peritoneal surface of a newly formed hernia is smooth, shiny and slightly moist, and consists of a thin connective tissue membrane poorly provided with blood vessels, but with a good supply of sensory nerves.

The peritoneum is very sensitive to irritating influences, such as inflammation, the pressure of a truss and the friction of clothing. In old hernias the sac becomes thickened and dry, and the delicate peritoneal nerve endings disappear. These sacs are often grayish in color and calcium deposits may be seen at different points. Weak portions of the sac often stretch and form diverticula, and firm fibrous adhesions may develop between the sac and its contents. Old hernias usually present folds and wrinkles that run in a longitudinal direction.

In inguinal hernia the sac may be quite thick, while in large umbilical and occasionally in femoral hernias, it is so thin that the peristaltic movements of the intestines can be seen. In rare instances, the sac wall may be the seat of tuberculosis or of malignant involvement.

Types of Sac.—There is a wide variation in the shape of hernial sacs, which is due to one or more of the following factors: The location of the hernia; the pressure exerted by the unyielding walls of the hernial canal, or by structures outside of the sac; the effects of irritation within the sac, or outside of it; and finally, the change in shape that naturally follows the increase in size of the hernia.

The form of the sac is also influenced by the existence of diverticula or constrictions within the sac or outside of it. The sac may be unilocular, or multilocular when longitudinal or transverse septa are present. A sac narrowed at two or more points is called a "rosary sac." Hydrocele is often associated with inguinal hernial sacs, and gives the latter an oval or pear-shaped contour.

Contents of the Sac.—Every abdominal organ has been found in the hernial sac. The viscera that normally have the greatest range of movement are found in the sac most often, and in their order of frequency are: Omentum, ileum, jejunum, sigmoid, cecum, appendix, ascending colon, descending colon, bladder, ovary, tube, stomach, liver, etc.

The omentum usually enters the sac while the ring is still small, and the small intestine descends after the opening has attained a fair size. The first foot of ileum above the ileocecal valve is the portion of small intestine most often found in the sac. It normally lies in close proximity to the internal inguinal and femoral rings, and on account of the long mesentery, it has more freedom of movement than any other part of the intestine.

Relation of Omentum to Intestine in the Sac.—As first pointed out by LeDran, in 1731, the omentum enters the sac first and lies in front of the intestine, and for this reason, in employing taxis, it is important to reduce the posterior portion of the hernial contents first, and then, the older omental contents that lie in the front of the sac. When omentum remains in the sac any length of time, it usually becomes adherent to the sac wall; it seldom adheres to the intestine unless inflammation develops, such as appendicitis or peritonitis in the hernial sac.

If the adhesions are extensive, especially around the neck of the sac, the hernia is often irreducible. In obese subjects, irreducibility is also favored by extensive fatty infiltration of the omentum and mesentery. Omentum is seldom found in the sac of inguinal and femoral hernia in young children. It hardly ever reaches as low as the pubes until after the second year of life. In adults and the aged, omentum is the most common hernial content.

The mesentery is short in young children, and for this reason, only a small knuckle of intestine is found in the sac ordinarily. The length of the mesentery increases with age, and in adults and elderly subjects it is possible to draw down many loops of small intestine and sometimes large intestine, to a point within the mouth of an inguinal or femoral hernia.

If a loop of intestine remains in the sac for some time, it undergoes certain changes on account of its abnormal position, and the disturbances in its blood supply. It becomes lighter in color, its surface rougher than abdominal intestine, and its mesentery elongates and increases in size as the loop slides further down into the enlarging sac. When only a portion of the wall of the intestine is in the sac, the hernia is termed a partial enterocele or Richter's hernia. When the sac contains a Meckel's diverticulum, the hernia is sometimes termed a Littré's hernia.

In sliding hernia (*hernie par glissement*), part of the large intestine, usually the sigmoid or cecum, enters the hernia by slipping with the peritoneum. The sac is present in front, but absent behind where the intestine and sac wall are closely adherent.

Foreign Bodies in the Sac Contents.—Foreign bodies are sometimes found in a hernial sac. Lipomas, that have become detached, shriveled up and hardened, are most often found; they may undergo fibrous or calcareous changes, and lie free in the sac, or they may be enveloped by the sac contents. Other substances may be found in the sac, such as pins, needles, tacks, nails, shot, bits of glass, enamel, bones, etc., which have worked their way through the intestinal wall, although sharp-pointed objects may enter the sac by penetrating its coverings or by migrating from another region of the body.

Bailloul reported an interesting case of a soldier, who received a gunshot wound in the right costolumbar region. Five months later he noticed a left inguinal hernia, in which he could feel a bullet, that would reduce easily

with the omentum into the abdomen. At operation a shrapnel ball was found buried in adhesions in the edge of the omentum.

Lane reported a case of umbilical hernia with symptoms of severe peritonitis in a woman, aged 52. Operation disclosed a perforation of the intestine and a rent in the hernial sac, which were due to a piece of bone that measured $\frac{3}{8} \times 1\frac{7}{8}$ inches (1x4.5 cm.).

Diseases of the Hernial Sac.—The hernial sac is often involved when the hernial contents are diseased, especially in case of tuberculosis and malignant growths. In 700 operations on children, MacLennan found adrenal rests in the sac wall six times. All of these occurred in males with inguinal hernia. Saint and others have also observed adrenal rests in inguinal hernial sacs.

Diseases of the Hernial Contents.—The hernial contents are sometimes affected by tuberculosis, hydrocele, calcareous deposits, mesenteric and intestinal cysts, and benign and malignant growths. Tuberculosis and new growths usually involve the hernial sac early in the course of the disease. Echinococcus occasionally occurs in hernial sacs, in patients living in tropical countries. The size of the swelling is variable; it is sometimes bilobed, and the mass may be fluctuating or solid, depending on the tenseness of the contents. Devé stated that the hernial cyst is due to secondary infection of the peritoneum, usually from the liver. Thomas found a *Porocephalus* larva in a hernial sac.

New Growths.—New growths involving the hernial contents and the sac are very rare. Arnaud, in 1749, found a carcinoma of the intestine in a hernial sac. Gros-Devaud, in 1902, was able to collect only 14 cases of cancer in the hernial sac from the literature. A few cases of cancer of the mesentery alone in a hernial sac have been reported; in Vaughan's case it was the cause of incarceration. Pileher reported a case of sarcomatous degeneration of a hernial sac. Sonnenburg found a large intestinal polypus in a hernia. Lejars observed a fibrosarcoma of the mesentery, adherent to the intestine in an inguinal hernia in a man, aged 33 years. Imbert reported the case of a woman, aged 42 years, who had a painful and irreducible umbilical hernia. At operation an epithelioma of the transverse colon was found in the sac. Lecène observed a cyst the size of two fists involving the mesentery of the ileum in an inguinal hernia.

ETIOLOGY OF HERNIA

Predisposing Causes of Hernia.—The principal cause of hernia is undoubtedly the existence of a congenital sac. Other predisposing causes are: Congenital weakness of the hernial ring, heredity, age, sex, pregnancy, obesity, trauma and certain diseases.

a. **Heredity.**—The transmission of congenital defects plays a small but definite rôle in the cause of hernia. Statistics show that about 25 per cent of the patients give a history of hernia in their parents or grandparents. Macready stated that a father having hernia tends to transmit a more marked predisposition to his sons than to his daughters, and a mother transmits a greater

predisposition to her daughters than to her sons, and she seems to have a tendency to transmit femoral hernia more than any other variety to children of both sexes. The tendency of hernial predisposition transmission from father to son and from mother to daughter, may be explained partly by the fact that men are more subject to inguinal hernia, and women to umbilical and femoral hernia, by reason of conditions peculiar to each sex. I recall a patient with inguinal hernia associated with partially descended testis, who said that both his father and paternal grandfather had the same condition.

While it is true that hernia is more common in some races than in others, the fact is probably due more to poor physical development and laborious occupations than to hereditary influence.

Thurston and Connor have pointed out that in India hernia of the large intestine, especially cecal hernia, is common, owing to the effects of a bulky vegetarian diet. The intestine becomes larger and more mobile than is the case in meat-eating races.

b. **Age.**—Age is an uncertain factor in the cause of hernia, especially in the inguinal and femoral varieties, when the sac is of congenital origin. Even when the hernia does not appear until adult life, the sac has undoubtedly been present since birth, and required only some unusual strain to force down the contents.

Inguinal hernia is most commonly seen in both males and females during the first year of life (15 per cent). From this time it diminishes in frequency until the age of adolescence, when it again increases, and remains a frequent occurrence during the active years—from 15 to 50—when the percentage again falls. In females hernia is infrequent until adult life, and then it occurs later than in males, and its frequency declines later—after sixty-five years it is rare.

In both males and females right inguinal hernia is the most frequent variety throughout life. Femoral hernia occurs slightly earlier in females than in males, and is most frequent during the active years of life in both sexes.

c. **Sex.**—Inguinal hernia occurs about nine times more frequently in males than in females; while femoral hernia occurs three times more often in females than in males. In 8,655 cases of inguinal and femoral hernia in soldiers reported by Perassi, 8,563 were inguinal and 92 femoral. In 2,769 cases collected by Malgaigne, 2,205 (80 per cent) were in males and 564 (20 per cent) in females. In 21,795 cases collected by Macready, 18,223 (84 per cent) were in males, and 3,572 (16 per cent) in females. In 70,090 observed at the Hospital for Ruptured and Crippled (New York) and reported by Coley, 53,009 (75.7 per cent) were in males and 17,081 (24.3 per cent) in females.

In 10,000 cases of hernia studied by Berger, 7,433 (75 per cent) were in males and 2,554 (25 per cent) were in females. He estimated that the proportion of ruptured males in the population was 1 to 14.9, while the proportion of female ruptured was 1 to 44.7. He found that in both sexes the lowest number of hernias occurred between the ages of 10 and 35 years, and after 35 the fre-

quency gradually increased, reaching its maximum in males at 70, and in females at 65.

Inguinal hernia is more common on the right side, especially in males, and the disproportion is most marked in infants and children.

RELATIVE FREQUENCY OF THE VARIETIES

(Eccles)	INGUINAL	FEMORAL	UMBILICAL
Males	96.33	2.53	1.14
Females	50.6	33.5	15.9
(Macready)			
Males	97.5	2.5	
Females	60.3	39.7	

The Relative Frequency of Inguinal and Femoral Hernia in the two Sexes.

—According to Macready, inguinal and femoral hernia are divided between the sexes as follows:

Female inguinal	8.5
Male inguinal	83.5
Female femoral	5.9
Male femoral	2.1
	<hr/> 100.0

Double Hernia.—Double hernia occurs on both sides at the same time in 4.6 per cent of males and in 3.1 per cent of females who have hernia. It is usually inguinal and 48.9 per cent of the cases in males, and 41.7 per cent of the cases in females develop during the first year of life. As life advances, single hernias become double in 36.6 per cent of males, and in 23.3 per cent of females. The tendency to double inguinal hernia and double femoral hernia is greater in males than in females. Left inguinal and left femoral hernia in the same subject more often become double, than right inguinal and right femoral hernia.

Obesity.—Obesity is an important predisposing cause of hernia in women. The fatty infiltration of the omentum and mesenteries and the accumulation of large quantities of fat in the anterior abdominal wall increase intraabdominal tension. This extra weight and strain result in a general relaxation and atony of the muscles in this region, causing them to separate at their weakest point, which is usually the umbilicus.

Pregnancy.—The marked distention of the abdomen during pregnancy results in an atrophy of the muscles with a tendency for them to separate at the umbilicus. Increasing obesity usually follows repeated pregnancies, furnishing an additional influence.

Deficient Musculature.—Deficient or poorly developed muscles or fascia are sometimes predisposing factors in certain varieties of hernia, especially in direct inguinal hernia, hernia through the linea alba, and lateral ventral hernia. In direct inguinal hernia the muscle development is defective at the weak spot in Hesselbach's triangle.

Prolapse or Abnormal Length of the Mesentery.—The average length of the mesentery in adults is 6 to 7 inches (15 to 17.5 cm.). It was formerly

thought that a long mesentery was a predisposing factor to hernia, but with the present knowledge of congenital sacs, this idea has been abandoned.

Other Predisposing Causes.—The following factors may also favor the occurrence of hernia: An increase in the bulk of abdominal viscera, such as enlargement of the liver or spleen, new growths, deposits of fat in the omentum and mesenteries, ascites, and certain occupations that necessitate a kneeling or stooping posture and relax the abdominal muscles and potential rings. In the aged, urethral obstruction or prostatic disease may be an aggravating factor. In rare instances, phimosis may be a predisposing cause in children.

Congenital Sacs.—At the present time the generally accepted cause of inguinal and femoral hernia is a preformed or congenital sac. Murray made postmortem examinations on 100 subjects who had no hernia during life, and found 21 potential or empty sacs, all femoral except one.

Exciting Causes.—The principal exciting cause of hernia is an increase in intraabdominal tension, which may be due to straining, such as coughing, lifting, etc., or to external violence or trauma, such as a blow, a fall from a height or a crushing injury. It may be due also to any condition that diminishes the capacity of the abdominal cavity. Whooping cough is a common exciting cause of hernia in children. Bronchitis, the cough associated with tuberculosis, emphysema and asthma, are occasionally exciting factors.

Berger examined 4,621 patients from the standpoint of etiology. Fourteen hundred and twenty-seven (30.9 per cent) stated that their hernia was due to a specific exciting cause; of these 438 claimed that their hernia followed a fall, a false step, or a strain caused by an effort to prevent a fall.

In 502 cases of umbilical hernia in adult females at the Hospital for Ruptured and Crippled (New York), and reported by Coley, the cause of the hernia was unknown in 204. In 195 it was attributed to pregnancy; in 83 to strain; in 8 to coughing; in 6 to a fall; in 3 to obesity; in 2 to ascites; and in one patient the hernia was congenital. In 4,780 cases of hernia in males, over 15 years of age, the cause was unknown in 3,102. In 1,695 the development of hernia was ascribed to an exciting cause; in 1,015 of these it was attributed to lifting, or carrying a weight; in 150 to coughing or sneezing; in 123 to strain; in 89 to a fall; in 40 to a blow on the abdomen or groin; in 14 to local trauma; in 8 to a kick; and in 51 the hernia had been present since birth.

Traumatic Hernia.—The sudden occurrence of hernia following a blow or a crushing injury is very rare. However, Mock stated that in industrial surgery it is not as rare as was formerly supposed.

The sudden appearance of the hernia is accompanied by pain, swelling, edema, and usually ecchymosis of the hernial coverings. The relation of hernia to industrial surgery is becoming more and more important. (This subject is discussed in the medico-legal chapter.)

Artificial Hernia.—In some countries it is a common practice for youths who wish to escape military service to produce a hernia by stretching the external inguinal ring and enlarging the inguinal canal by means of a blunt

pointed stick or other instrument or by digital dilatation. At the same time, violent sneezing is induced by inhaling snuff, and in two or three days the subject has a well-developed hernia. Graser stated that these hernias can be distinguished easily from ordinary ones, because in the induced hernia the external ring is nearly always irregular, jagged and infiltrated with inflammation, and often there are unusual openings in the aponeurosis of the external oblique. A Russian writer, whose name I do not recall, reported the case of a young man who produced an artificial hydrocele by cutting the skin at a point on the scrotum, introducing a goose quill, and blowing air into the subcutaneous tissues. He closed the skin aperture with a piece of putty.

SYMPTOMS AND DIAGNOSIS OF HERNIA

From a clinical standpoint it is most convenient to classify hernias in general into the following varieties:

1. Reducible.
2. Irreducible.
3. Inflamed.
4. Obstructed.
5. Strangulated.

The diagnosis of reducible hernia is almost always easy, but the other varieties may present unusual difficulties.

Reducible Hernia (Free Hernia).—A reducible hernia is one in which the contents of the sac can be returned to the abdominal cavity. Almost every hernia is reducible in the beginning, the contents returning to the abdomen spontaneously when the patient assumes a certain posture, or when taxis is employed.

A. Functional Symptoms.—A swelling is usually the first sign of hernia. The symptoms depend on the age of the patient, the location of the hernia, and its period of duration. It probably takes weeks or months for the ordinary hernia to become large enough to be noticed. The preformed sac is very small; usually no larger than a goose quill.

a. Premonitory Symptoms.—Some writers have attached importance to premonitory pains as a symptom of an impending hernia; although these are too uncertain to be of much clinical value, I have occasionally seen children who complained of pain in the inguinal region for a few weeks previous to the appearance of the swelling, and it is not uncommon for recurrent hernias to cause the patient considerable pain and discomfort before a bulge at the internal ring can be detected.

b. Later Symptoms.—The symptoms of hernia differ in children and adults. In children the swelling may be over the umbilicus or in the groin, following whooping cough, or some other exciting cause, or it may appear without any apparent reason. The hernia comes down when the child cries, or when playing, and while it is down the child is uncomfortable, restless and irritable. The hernia is nearly always easily reduced. (I have known these little

patients to stop playing, lie down, reduce their hernia by pressure with the fingers, get up and return to play.)

In adults pain is the symptom most commonly complained of. It is especially annoying while the hernia is small, before the hernial rings, canal and surrounding structures have become stretched. The pain and discomfort are usually worse after standing or walking for several hours. There are often headache, digestive disturbances, such as flatulence, colic, and vomiting; when the hernia is obstructed, constipation is the rule, and in hernia of the sigmoid, it may be very marked. Pain is most often complained of when the viscera are descending into the sac, or when they are being reduced.

A patient involuntarily protects the side of the hernia by making pressure with his hand, when coughing, sneezing or straining. If the bladder is involved, there will be disturbances in urination and in rare instances micturition is accomplished in two stages.

B. Physical Signs of Reducible Hernia.—a. *Inspection.*—By inspection the location of the tumor can be ascertained and its general shape noted; it may be oval, oblong, pear-shaped, pedunculated or pendulous. Any change in size when the patient stands up or lies down should be observed. When the sac wall is very thin and the hernia large, the intestinal coils can be seen in outline. A hernia is often more easily seen than felt. Before looking for a small hernia, the patient should be asked to strain or cough.

b. *Palpation.*—If the mass can be returned to the abdomen, the diagnosis of hernia is usually positive. As the hernia is reduced, it feels to the examiner like a solid or semi-solid doughy mass, slipping through his fingers. If intestine is in the hernia a distinct gurgling can be heard and felt.

A definite impulse, a tapping impact on coughing, is one of the most valuable signs of hernia, and may be elicited if the examiner places his hand over the hernia, or in the case of inguinal hernia with a large opening, by inserting his finger in the inguinal canal. To explore the canal the index finger should be placed on the front and lower part of the testis, and pushed upward invaginating the scrotum as it passes the external ring. By beginning the invagination low down on the scrotum, the examining finger obtains the greatest freedom of movement in the inguinal canal.

The examiner should never, under any circumstances, dilate the inguinal canal in order to palpate the internal ring. This practice is to be vigorously condemned as it is a frequent cause of hernia. While intestine returns to the abdominal cavity with a gurgling sound, omentum goes in noiselessly. When intestine and omentum are both in the sac, the intestine reduces first and is followed by the omentum. When intestine is alone in the sac the last part of it goes in suddenly.

After the hernia is reduced it is usually possible for the examining finger to follow it up, and determine the size and shape of the internal opening, the condition of the hernial canal, and the development of the muscles and fasciae that are available for repair.

c. *Percussion*.—If the note on percussion is tympanitic, it is almost certain that one or more loops of intestine containing gas, are in the hernia. If the note is dull, it usually means that considerable omentum is in the sac; or if there is intestine, it is empty or flaccid, or else it contains solid contents. A dull note may also be elicited when the omentum overlies the intestine.

A dullness over a direct inguinal hernia should put the examiner on his guard for hernia of the bladder. Dullness over a scrotal hernia suggests a complicating hydrocele.

d. *Auscultation*.—The gurgling sound of a reducing intestinal hernia can be heard sometimes at a distance of several feet from the patient. An absence of gurgling means that the hernia is omental, that the intestine contains little or no gas, or that the internal ring is large in proportion to the size of the sac. Absence of peristaltic sounds in strangulated hernia is a grave sign and calls for immediate operative intervention.

e. *X-Ray*.—In nonstrangulated hernia it is sometimes possible to determine the contents of the sac and to distinguish between large and small intestine by roentgen-ray examination after an opaque meal, as suggested by Pirie, Báron and Bársony, and others. Marchetti diagnosed a sciatic hernia of the sigmoid before operation by roentgen-ray examination.

Hernia in Relation to General Health.—The ill effects of hernia on the health are well known, and the severity of the symptoms depends on the situation of the hernia, and its contents. Some hernias give rise to considerable pain, especially hernias through the linea alba and obturator hernia. In certain instances, especially in epigastric hernia, the gastrointestinal symptoms are out of all proportion to the size of the tumor. The cure of the hernia not only improves the patient's general health, such as overcoming constipation, headache, nervousness, etc., but certain neuroses, as hysteria and neurasthenia often disappear.

DIFFERENTIAL DIAGNOSIS OF REDUCIBLE HERNIA

Reducible hernia is most frequently mistaken for hydrocele. Other diseases that may simulate hernia are: Lipoma, adenitis, varicocele, saphenous varix, cold abscess, cysts and new growths.

1. **Hydrocele**.—Scrotal hernia is liable to be confused with hydrocele. In hydrocele there is no impulse on coughing, the tumor is not reducible, and on percussion the note is dull. There is an absence of digestive symptoms and pain in the inguinal region, and the hydrocele is translucent. In hernia in infants and young children, the intestinal wall is very thin and sometimes translucent; this point should always be remembered.

2. **Lipomata**.—Hernia through the linea alba, small umbilical hernia, and femoral hernia are to be differentiated from lipoma. Lipoma occurs most frequently in the linea alba above the umbilicus, and is often adherent to a small peritoneal sac. A femoral lipoma is movable, gives no impulse on coughing,

cannot be traced directly into the femoral canal, and does not change size or position when the patient stands up or lies down.

3. **Adenitis.**—Inguinal and femoral hernia are to be distinguished from adenitis. Subacute or chronic adenitis, especially of tuberculous origin, sometimes presents the greatest difficulty. Cases are on record in which a suppurating lymph gland overlay a strangulated femoral or obturator hernia. The history of reducibility in the early stage of the swelling may be the only symptom pointing to hernia.

4. **Varicocele.**—Inguinal hernia must be distinguished from varicocele only in rare instances. In varicocele the tumor disappears when the patient lies down, even though the examining finger makes firm pressure at the external ring, and it reappears when the patient stands up, even when pressure is continued. Varicocele gives a characteristic thrill on coughing, like fluid being dashed against the fingers.

5. **Saphenous Varix.**—Femoral hernia sometimes has to be differentiated from saphenous varix. Saphenous varix has the same signs that are found in varicocele. (See chapter on femoral hernia.)

6. **Cold Abscess.**—Occasionally inguinal and femoral hernia must be distinguished from cold abscess. Cold abscess usually follows tuberculous osteitis of the vertebrae, or one of the pelvic bones. When the abscess appears in the femoral region it resembles a femoral hernia in that it is reducible and has an impulse on coughing. However, unlike femoral hernia, it presents fluctuation, and bimanual pressure shows that the external and internal swellings communicate, and that fluctuation is easily transmitted from one to the other. Examination of the patient's back will generally disclose marked rigidity of the spine or osteitis of the vertebrae.

Cold abscess in the inguinal region may be due to tuberculosis of the pubic bones. The swelling is usually outside of the inguinal canal; there is no impulse on coughing and the inguinal canal is empty.

7. **Cysts.**—Inguinal and femoral hernia are to be distinguished from cysts. A labial hernia may simulate a cyst of Bartholin's gland. In the latter condition the tumor is of slow growth; it is dull on percussion, translucent, and the inguinal canal is empty.

Sometimes hernia cannot be differentiated from cysts of the spermatic cord and hydrocele of the canal of Nuck, if they are small and lie in the inguinal canal. If a portion of the hernial sac becomes shut off from its communication with the abdominal cavity, a cyst is liable to form; if the sac is shut off at more than one point, there may be multiple cysts.

8. **New Growths.**—In rare instances hernias must be distinguished from benign and malignant growths, such as occasionally develop in the spermatic cord of an undescended testis, or in the round ligament that lies in the inguinal canal.

The Formation of an Abscess Outside of the Hernial Sac.—The formation of an abscess outside of the hernial sac is a rare complication, and usually

occurs in elderly patients who have had a reducible hernia of long standing. Following increasing pain and tenderness, the hernia becomes irreducible with symptoms of inflammation. The symptoms are not as acute as when the inflammation is inside of the hernial sac.

The treatment consists in incising and draining the peri-hernial abscess, and operating on the hernia at a subsequent time to prevent the recurrence of the condition.

Hernia in the Chronic Insane.—Jackson found 79 cases of inguinal hernia in 1,237 insane male patients. He stated that palliative treatment was usually employed, and the danger of overlooking strangulation was guarded against by frequent examinations. Operation for nonstrangulated hernia is usually not recommended because strangulation is rare. The life expectancy of senile dementia patients is short under the most favorable conditions. The use of general anesthesia is contraindicated in paretics because of the danger of producing a prolonged postoperative excitement stage. This excitement does not follow general anesthesia in mania, even when the patient has to be restrained.

PROGNOSIS OF REDUCIBLE HERNIA

The prognosis of untreated reducible hernia is always serious.

Infants and Young Children.—While a majority of inguinal and umbilical hernias in infants (under two years of age) can be cured by mechanical treatment, there is the danger that the hernia will slip by the truss and strangulate. However, at this age strangulation is not common. While there is a tendency on the part of some general surgeons to operate on young children earlier than formerly, I believe that, as a rule, mechanical treatment should be given a trial for small, easily retained hernias in children under four years old. Operative treatment at this age is attended by more dangers than in older children. (See chapter on inguinal hernia in children.)

Older Children and Adults.—The radical operation is always to be recommended as the treatment in young children when the hernia cannot be controlled by a truss, or when the hernial opening does not decrease in size under palliative measures. In older children and adults the operation offers the only prospect of cure, the danger is very slight, especially with local anesthesia, and the percentage of recurrence is very low.

The Aged.—To those patients in the advanced years of life all surgical procedures carry a multitude of dangers, the principal ones, perhaps, being the general anesthetic and the confinement to bed.

Fortunately, the primary development of hernia in the aged is infrequent, probably because these individuals avoid heavy labor in an effort to conserve their declining physical powers, consequently they are exempt from the usual causative factors of hernia that apply to the active years of life.

The possession of a small reducible hernia is apparently more of an asset

than a handicap; unless it becomes strangulated it does not shorten the duration of life, and it compels the individual to take care of himself, to avoid the heavy work and exposure with their attending wear and tear on the body, which is the usual lot of the elderly individual who is sound.

The hernia of the aged is usually more difficult to control with a truss on account of the relaxation of the hernial rings. When operation is indicated, the danger can be minimized by the use of local anesthesia, and the period of confinement is shortened because recuperation is more prompt than after general narcosis.

TREATMENT OF REDUCIBLE HERNIA

The treatment of reducible hernia may be either mechanical or operative:

1. Mechanical Treatment.—Mechanical treatment consists of reducing the hernia and keeping the contents retained in the abdominal cavity by means of a suitable bandage or properly fitting truss, until the hernial opening closes spontaneously. The indications for mechanical treatment for the different varieties of hernia are considered in their respective chapters.

2. Operative Treatment.—Operative treatment of reducible hernia is to be advised when there is little prospect of a spontaneous cure, when the truss cannot be tolerated, and when it does not retain the hernia.

In general, the steps of the operation for reducible hernia are carried out in the following manner: An incision is made over the center of the hernia, the sac exposed, freed, opened, drawn out, the adhesions to the sac wall separated, the sac ligated at its neck and excised. The hernial opening is closed, the canal obliterated and the abdominal wall closed in layers. The operative technic for the hernias in the different regions, is taken up in their respective chapters.

GENERAL PRINCIPLES OF OPERATIVE TREATMENT

Sterilization of Dressings, Sponges, etc.—The importance of properly sterilized dressings, sponges, sheets, towels, etc., cannot be too strongly emphasized. Some good hospitals are occasionally careless in this respect. The surest way to be certain about asepsis is to use controls with each sterilization; the control melts when sterilization is complete.

Sterilization of the Skin.—As a rule, the field of operation should be prepared 12 to 24 hours before the operation. The skin should be scrubbed with soap and water, using a soft bristled brush, sponge, or a gauze compress, for a distance of several inches beyond the field of operation. If the region is covered with hair, it should be shaved. A dry sterile dressing is applied and left on until the patient is on the operating table, when it is removed, and the skin painted with one or two coats of tincture of iodine solution (3 per cent) or picric acid solution. If the skin is moist, it should be dried with alcohol before the iodine is applied.

In emergency operations the skin should be shaved, scrubbed, thoroughly dried, wiped off with benzin or gasoline, and finally a coat of iodine applied. To prevent dermatitis, the excess of iodine should be removed within five or ten minutes by sponging with alcohol, or by applying a 5 per cent solution of hyposulphite of soda.

Picric Acid Method.—Many operators prefer picric acid to iodine as an antiseptic for the skin, because it is less irritating and is just as powerful an antiseptic. Picric acid is dissolved in alcohol, the strength of the solution varying from 1 to 5 per cent, and as pointed out by Hewitt it does not irritate the peritoneum.

Some operators prefer a moist antiseptic dressing, such as a $\frac{1}{10,000}$ bichlorid of mercury solution. Others favor the acetone-pyoxol solution, recommended by McDonald, which is prepared by dissolving 40 parts of commercial acetone and 2 parts of pyxol in 60 parts of denatured alcohol; this solution is also used to sterilize the operator's hands, and its antiseptic action is not diminished by a small amount of water.

MacFarlan, McKenna and Fisher recommended the use of a 1 per cent solution of potassium-mercuric iodide in acetone. This antiseptic is superior to iodine because of its solvent action on natural fats, its greater penetrative properties, and it does not blister or irritate the skin.

Sterilization of Instruments.—It is the usual practice to sterilize noncutting surgical instruments by boiling them in a 1 per cent sodium carbonate or sodium bicarbonate solution. Instruments sterilized in this manner rust very easily, as the sodium carbonate or sodium bicarbonate does not combine with the carbon dioxide in the water; the carbon dioxide in the water causes the rusting. To prevent rusting, I boil the instruments in a $\frac{1}{4}$ per cent solution of sodium hydroxide. The solution should be allowed to stand two minutes before putting in the instruments, to allow the sodium hydroxide to combine with the carbon dioxide in the water.

Scissors, scalpels, needles and other cutting instruments, are best sterilized by soaking in phenol and rinsing off in alcohol just before use.

Rubber Gloves.—Rubber gloves should always be used by the surgeon and assistants during hernia operations to prevent infection, thus lessening the danger of recurrence. Gloves can be boiled with the instruments or sterilized by dry air, and they should never be used when they have even small holes in them.

Operating Gowns.—The operator, assistants and spectators should wear gowns. The surgeon and assistants should wear gowns with long sleeves so that the wristlets will be covered by the wristlets of the gloves.

Caps and Face Masks.—The operator and assistants should always wear caps and gauze face masks, covering the head and mouth, in order to lessen the danger of infection. Before caps and masks came into general use it was not an uncommon thing to see dandruff fall into the wound, and it was impossible for the operator or assistants to talk without particles of saliva

being projected there also. For those who wear glasses, it is a good plan to attach a piece of adhesive plaster to the upper edge of the mask covering the mouth and nose. The adhesive strip is attached to the cheeks just below the eyes and effectively prevents steaming of the glasses.

The Light on the Operative Field.—When emergency operations are performed in the home, it is often difficult to secure adequate light on the field of operation, especially at night, if electric lights are not available. Under such circumstances, a strong pocket flashlight is most helpful. Unless the ordinary landmarks can be readily identified, there is always danger of cutting into the bladder or losing one's bearings.

Suture Material.—Catgut was first used for sewing wounds by the ancient Egyptians, and Rhazes speaks of the use of harp strings for this purpose. Because all wounds suppurated, nonabsorbable suture material was generally employed up until the introduction of antiseptic surgery by Lister. Antiseptic catgut was first used in the modern operation for hernia by Marey in 1871, who was a pupil of Lister.

The selection of the proper suture material is one of the most important factors in the prevention of the recurrence of hernia. I believe that absorbable suture material should always be employed in all varieties of hernia operations.

The deep sutures should be of chromicized kangaroo tendon or catgut No. 2. However, plain catgut No. 2 is probably just as good. The kangaroo tendon absorbs more slowly than the catgut. Reindeer tendon is used in some countries; this lasts from four to six weeks. No. 1 plain catgut is sufficient for ligating blood vessels, suturing the peritoneum, subcutaneous tissues and skin. Some operators prefer to suture the skin with linen, silk, or silkworm, which is removed in five to seven days. Personally, I prefer to close the skin with a continuous subcuticular suture of horsehair, because it is the least irritating; sterile pus does not accumulate at the points where the thread pierces the skin, consequently the wound heals quickly, and with less scar than when capillary suture material is employed. There is a noncapillary silk suture on the market known as equisetene, which possesses all the advantages of horsehair. It can be obtained in different sizes, and is not expensive. (For additional details on sutures, see chapter on the inguinal hernia operation.)

Disadvantages of Silver Wire.—The use of silver wire sutures or fligree, is never to be advised. The wire often delays healing and may be the cause of suppuration. In time, the imbedded wire has a tendency to erode, crack, and if it becomes detached, it may injure a large blood vessel, or enter the bladder, intestine or abdominal cavity as a foreign body.

Blood Vessel Suture.—For closing accidental wounds in blood vessels, the operator should always have very fine, straight needles (No. 16) convenient, and very fine thread (No. 00000 twist black silk). Both the needle and thread should be sterilized in vaseline.

If the cut is extensive, the method of suture devised by Horsley is to be recommended. Briefly, the steps are as follows: The wounded vessel is exposed, the blood stripped from it, and light clamps applied above and below the cut. If the margins are ragged or bruised, they are trimmed with sharp scissors. If the transverse wound involves more than half of the circumference of the vessel, the latter is completely divided and united by end-to-end suture. The adventitia is trimmed away along the edges of the wound, the blood clots removed, the edges of the wound and the intima washed with Locke's solution and smeared with sterile olive oil.

If the cut is parallel with the vessel, it is sutured with a cobbler's stitch, using fine straight needles (No. 16), and fine black silk, sterilized in vaseline. The suturing is often facilitated by grasping the vessel with Horsley's curved blood vessel forceps. When the wound in the vessel is transverse, Horsley's suture staff is slipped beneath the vessel, and the edges approximated by placing a guy suture at each end of the wound. The tension of the staff is sufficient to evert the intima while the wound is closed with a cobbler's stitch. Care should be taken to secure the beginning of the suture line by taking a back stitch well beyond it.

When the vessel wound is inaccessible, it sometimes is necessary to place a long guy suture at each end of the wound, and close the opening with a continuous overhand stitch of black silk threaded in a very fine round full curved needle (No. 16). This stitch permits more leakage from the needle holes than the cobbler's stitch, and also increases the danger of thrombosis.

Suture Needles.—The needles ordinarily employed for hernia operations are the same as those used in any abdominal operation. For closing the peritoneum and transfixing the sac preliminary to ligation, a sharp-pointed round full curved needle is very satisfactory. For the deep sutures in muscle and fascia a heavy, round full curved needle is the best.

Some surgeons prefer a Hagedorn full curved needle for the deep sutures. Many use a blunt-pointed full curved needle to lessen the danger of wounding the deep vessels in operations for inguinal and femoral hernia. De Garmo employed a full curved round cervix needle, with the point filed off. A number of instances are recorded in the literature, in which the vessels have been wounded while the deep sutures were being inserted. (See chapter on treatment of inguinal hernia—accidents following operation.)

Medium-sized round full curved needles are ordinarily employed for closing the subcutaneous tissues. For the skin, a sharp-pointed cutting edge needle, either straight or curved, is used. The subcuticular suture is the best for the skin closure, and approximation is most accurate if a sharp straight needle is used.

For closing wounds in the intestine and bladder, straight, round milliner's needles are the best. Some operators use a double-pointed needle with a central eye, to save time in suturing. To prevent the thread from slipping, use a needle with a wedge-shaped eye. Self-threading spring

eyed needles are time savers, but are not as durable as ordinary needles. Allen devised a handy needle with a self-threading eye, which also prevents the thread from slipping. Reverdin's needle, which has a handle attached, is very popular in many countries. Printy's needle forceps are a time saver in suturing. This convenient needle holder has a ring for the thumb, and is held between the thumb and index finger. (Fig. 2.)

Abdominal Scars.—In operations for hernia it is seldom possible to place the skin incision so that it follows the natural folds of the skin, thus leaving the minimum amount of scar after healing has taken place. However, in certain hernias, especially in the umbilical and ventral varieties, it is often possible to make the incision in a fold of the skin, where the best cosmetic



Fig. 2.—Printy's needle holder. This handy forceps does not have to be removed from the thumb while tying sutures, and it will hold straight and curved needles.

results are obtained. Other measures that tend to lessen the amount of scar are: The prevention of infection, the use of noncapillary skin sutures such as horsehair, a short incision, a careful hemostasis, and the avoidance of drainage in clean cases.

Passot suggested that accurate approximation of the edges of the wound is assured if the sites for the stitches are marked on the skin with an indelible pencil before the incision is made. The wound is closed with a subcuticular suture and covered by a sterilized celluloid shield, held in place by adhesive straps passing across the wound.

After healing has taken place, gentle massage, and the occasional application of scarlet red ointment are of considerable value.

Hemostasis of Wound.—The importance of having the wound dry before closing it cannot be overemphasized. Hemorrhage from the wound or a

slight oozing after the patient reacts from the operation, is responsible for a certain percentage of the infected cases, even when the bleeding is not sufficient to produce an appreciable hematoma.

Cosmetic Incision.—A cosmetic incision for small inguinal hernia in women is made over the lower part of the inguinal canal and its upper end does not extend above the pubic hair line. (See chapter on the treatment of inguinal hernia.)

Painful Scars.—A painful scar is due to the inclusion of sensory nerve fibers in the sutures or in the skin cicatrix. In passing the deep sutures in inguinal hernia operations, it is very important to avoid pressure on the iliohypogastric or ilioinguinal nerves. (This point is discussed in the chapter on the treatment of inguinal hernia.)

When the pain is confined to the skin cicatrix, it may be relieved by massage and roentgen-ray treatment. If this fails it is necessary to excise the scar. The new wound must be closed carefully with horsehair sutures, in order to avoid the formation of new cicatricial tissue.

Adherent Scars.—Adherent scars in a hernia wound can usually be freed by massage in conjunction with mild counterirritation, such as hot dressings and roentgen ray treatments. In rare instances, it is necessary to resort to operative measures.

Cicatricial Keloid.—A cicatricial keloid is a hyperplasia of the scar tissues, which is sometimes tender and painful. The best treatment is massage and roentgen-ray. Operation is unsatisfactory, as the tumor nearly always recurs.

New Growths in the Incision.—The occurrence of new growths, either benign or malignant, in a hernia incision is very rare. They are most often found in the sheath of the rectus muscle and on the aponeuroses of the external and internal oblique muscles.

Several cases are recorded in the literature in which the growth has followed an incision in the abdominal wall.

Ossification of the Cicatrix.—Ossification of the cicatrix is very rare. Benelli reported a case in which a large calculus developed in the scar of a median abdominal incision. Diagnosis was made by roentgen-ray examination before operation.

THE COMPLICATIONS OR ACCIDENTS OF HERNIA

The complications of hernia are irreducibility, inflammation, obstruction, and strangulation. Irreducibility may be the only complication at first; if it is left untreated, inflammation often follows, favoring the occurrence of obstruction and strangulation. In strangulation all these complications may be present at the same time. For the sake of clarity, they will be considered separately in the order named:

IRREDUCIBLE HERNIA

Irreducibility.—An irreducible hernia is one whose contents cannot be returned into the abdominal cavity. The term is often applied to hernias that are partially reducible. Uncomplicated irreducibility is usually only a temporary condition and under proper treatment, such as rest in bed, restricted diet, and continued pressure on the tumor, or repeated taxis, the hernia will ordinarily become reducible again.

Irreducibility is most common in middle or advanced age; it is rare in children, because in them omentum is seldom in the sac. It is more frequent in females because they are more subject to femoral and umbilical hernia than males. It usually occurs in the obese and those who do heavy manual labor. Irreducibility may be due to one of the following causes: Adhesions of the omentum to the sac wall; adhesions between the sac contents, such as adhesions of the loops of intestine to each other, or to the omentum or to other viscera in the sac; an excessive deposit of fat in the omentum, mesentery, or in the appendices epiploicae in the sac; adhesions between different parts of the sac wall; an accumulation of intestinal contents in the loops within the sac; the narrowing of the neck of the sac, which may be due to inflammation in the sac itself, or to the irritation and pressure of a truss; and in sliding hernia of the intestine or of the bladder, irreducibility is due to a part of the viscus being adherent to the sac wall or, in rare instances, to the position of the viscus entirely outside of the sac (extrasaccular).

Sac Contents.—Omentum is the most frequent content of irreducible hernia, and is the usual cause of irreducibility. It becomes adherent to the sac wall early, and increases in size from fatty infiltration. Large intestine is more commonly irreducible than small intestine. The ovary and tube, bladder, cecum and sigmoid are sometimes found in the sac. Any of the other abdominal viscera may be found, but only in rare instances. When a part of the sac is shut off from the abdominal cavity, a hydrocele may develop.

Symptoms and Diagnosis of Irreducible Hernia.—The symptoms of irreducible hernia are similar to those of reducible hernia, with the exception that the mass cannot be returned into the abdominal cavity, either when the patient assumes the recumbent posture or when taxis is applied. At one of the hernial openings there is a well-defined protrusion, which has a history of a gradual increase in size, and of having been reducible in the beginning. There is a distinct impulse on coughing, and when the hernia is small there may be no general symptoms. In large hernias there are frequent attacks of pain, colic, and gastrointestinal disturbances usually associated with constipation.

The pendulous hernia causes a dragging sensation, often referred to the viscera that remain in the abdomen, such as the stomach, transverse colon or small intestine.

Contusion of Hernia.—Large hernias, especially if they are irreducible and in an exposed position, are subject to trauma from blows, falls and crushing injuries, which may result in rupture of the sac with extrusion of its contents.

The sac coverings are often very thin and ulceration of the skin from the irritation of clothing or bruising is not uncommon. Sometimes the intestine in the sac ruptures, while the coverings of the sac remain intact. Rupture of the intestine is always serious on account of the danger that the resultant peritonitis will extend to the abdominal cavity. Operation should always be resorted to immediately. Hindse-Nielsen collected from the literature 669 cases of rupture of the intestine. Two hundred of these patients were treated expectantly, and only 4 recovered, while of the remaining 469 patients treated by operation, 28 per cent recovered.

When acute symptoms follow injury to a hernia, operation should be resorted to immediately. A soft, tender fluctuating hernia accompanied by increasing rigidity of the abdominal muscles, indicates that the intestinal contents are escaping into the abdominal cavity, and that the symptoms of shock, and peritonitis will soon follow. (For additional details on contusion and rupture of hernial sacs, see chapters on umbilical and inguinal hernia.)

Prognosis.—The prognosis of irreducible hernia is more serious than for reducible hernia. On account of the exposed position of an irreducible hernia, the viscera in the sac are subject to frequent trauma from accidental blows or from the rubbing of clothing. As long as the hernia remains irreducible it is liable to become inflamed, resulting in obstruction and sometimes in strangulation.

The radical operation is the treatment of choice. Massive hernias of long standing that have lost their *right of domicile* in the abdomen, should not be operated on without preliminary treatment to enable the contents to be returned to the abdominal cavity without causing fatal cardio-vascular or pulmonary complications. (For details of preliminary treatment of massive irreducible hernia, see chapter on umbilical hernia.)

Treatment of Irreducible Hernia

The treatment of irreducible hernia is palliative or operative.

a. **Palliative.**—Palliative measures that aid in converting an irreducible hernia into a reducible one are: Rest in bed, with the foot of the bed elevated for several days or weeks; firm continuous pressure by a bandage which is tightened a little each day; gentle taxis daily, or two or three times a week; a diet consisting of nonfattening food, and free catharsis.

As soon as the hernia can be returned, a radical operation should be urged as there is no prospect of a cure by mechanical means, and the hernia is liable to become irreducible again.

b. **Operative Treatment.**—The operation is the treatment of choice for uncomplicated irreducible hernia. This hernia presents more difficulties

than the reducible variety, on account of the intrasaccular adhesions, the task of returning the hernial contents to the abdominal cavity and closing the wound.

INFLAMED HERNIA

An inflamed hernia is one in which peritonitis involves the sac wall or the contents. Inflammation in the hernia may be due to the following causes: Irritation from the rubbing of a truss or bandage; trauma, such as an accidental blow; attempts at taxis; inflammation extending from a loop of intestine in the hernia or from a diseased appendix; tuberculosis of the hernial sac; and new growths involving the abdominal viscera, the sac or contents.

Inflammation most commonly occurs in femoral hernia, and more frequently in umbilical than in the inguinal variety, consequently, it affects more women than men.

Symptoms

In acute inflammation of hernia, the symptoms are well defined. The mass is painful, tender on pressure, swollen, and edematous. Sometimes there is a localized redness of the skin at one point. There is usually fever and a slight acceleration in the pulse; sometimes gastrointestinal symptoms, such as nausea, vomiting and constipation are pronounced. The severity of the symptoms depends largely on what viscera are involved. If omentum alone is in the sac, the symptoms are usually mild and of short duration; if the appendix is in the sac and inflamed, the symptoms are severe, and unless relieved by operation, the condition usually terminates in abscess formation or in an extension of the peritonitis to the abdominal cavity. Cases have been recorded in which the skin over the irreducible hernia became irritated and infected, and the inflammation spread to all the hernial coverings, resulting in a rupture of the sac and extrusion of the viscera. In most instances death followed from peritonitis.

Prognosis

The prognosis of inflamed hernia is serious, especially so in the aged. The adhesions that follow a mild inflammation may cause the hernia to become permanently irreducible, and in this event, it is subject to attacks of obstruction and sometimes to strangulation.

Treatment

The treatment of inflamed hernia is nearly always palliative. The patient should be kept in bed. For children and adults, ice should be applied to the swelling, and for the aged hot compresses should be used. It is unwise to use ice for elderly subjects, because the skin over the hernia is of low

vitality and there is danger of producing gangrene. The bowels should be moved by enemata and no cathartics given until after the bowels move well. In case the inflammation terminates in suppuration, or if a hernia of the appendix is suspected, an exploratory incision is indicated.

INCARCERATED OR OBSTRUCTED HERNIA (CHOKED HERNIA)

An incarcerated or obstructed hernia is one that contains intestine whose lumen is occluded from within, without any disturbance in the blood supply of the intestinal wall. In incarcerated hernia the passage of both gas and feces is obstructed, usually on account of a fecal impaction or an accumulation of gas in a loop of intestine in the hernia.

Obstruction is most common in hernias of the large intestine, especially in umbilical hernia of the transverse colon, which occurs most often in women, and in inguinal hernia of the cecum or sigmoid usually found in men.

Symptoms

The symptoms of incarcerated hernia develop slowly and are very indefinite at first. There may be some pain in the hernia and a slight increase in size. On palpation its consistency is firmer than an unobstructed hernia, but it lacks the marked tenseness that is found in strangulation. If the fecal impaction is large, the hernia may feel like dough or putty, and is dull on percussion. There is a slight impulse on coughing.

There is usually vomiting, but it is not as severe as in strangulation, and it is stercoraceous only rarely. There are often colicky pains and abdominal tympanites. Constipation is marked, but it is seldom complete.

DIFFERENTIAL DIAGNOSIS OF OBSTRUCTED, INFLAMED AND STRANGULATED HERNIA

	OBSTRUCTED HERNIA	INFLAMED HERNIA	STRANGULATED HERNIA
Onset	Gradual	Gradual	Sudden
Impulse on coughing	Present	Present	None
Pain	Not marked	Not marked	Severe, over hernia and abdomen
Tumor	Little tenderness or tension	Tender, no tension	Marked tenderness, very tense
Vomiting	Usually absent	Slight	Severe, continuous
Constipation	Absent	Absent	Absolute
Prostration and shock	None	None	Severe in infants and the aged
Pulse	No change	No change	Rapid, later weak and thready
Temperature	Normal	Slight elevation	Elevated at first, later subnormal

Prognosis

The prognosis of incarcerated hernia depends on the duration of the symptoms and the age of the patient. In children and adults, when the symptoms are of recent onset, the outlook is usually favorable. In the aged, the prognosis

is always grave, because the symptoms are indefinite and of gradual development; they are liable to be confused with the ordinary complaints associated with old age, and strangulation may occur before the cause of the symptoms is recognized.

Treatment

If the possibility of strangulation can be definitely excluded, palliative treatment is indicated. The patient should be kept in bed with the foot of the bed elevated, and no food given by mouth. For adults ice should be applied to the swelling, and for children and the aged, hot compresses should be used. Except in cases seen a few hours after onset, taxis is dangerous and never to be recommended.

High enemata should be given frequently, and after the bowels move it is safe to give a laxative. If the obstruction is not relieved in a few hours, operation should be resorted to just as for strangulated hernia. If the diagnosis is not positive when the patient is first seen and there is a possibility of strangulation, operation should be undertaken immediately.

STRANGULATION

Definition.—A strangulated hernia is one which contains abdominal viscera whose blood supply is partially or completely obstructed.

Historical

The clinical characteristics of hernial strangulation were known to Hippocrates, who lived in the fourth century B. C. Taxis was practiced for its relief by Praxagoras of Cos in the third century B. C., who believed that strangulation was due to an accumulation of hardened feces in the protruded intestine. This theory was accepted by Celsus and Aretæus in the first century A. D., by Paulus Ægineta in the seventh century, by Avicenna in the eleventh century, and was not generally abandoned until the beginning of the nineteenth century.

Pierre Franco, in 1556, devised an operation for strangulated hernia. He suggested that sometimes the condition was due to an accumulation of gas in the hernial loop. He opened the sac only as a last resort, when the hernia could not be reduced after the division of the overlying tissues. In 1672 Lavater suggested that it was often due to pressure on the neck of the sac, and was sometimes the result of inflammation.

Riolan, in 1658, described the hernial rings and ascribed an important rôle to them in the production of strangulation. The operation was also described by Paré in 1579, and by LeQuin in 1697. Dionis in 1698, and Mauchart in 1722 stated that strangulation was due to a spasmodic contraction of the external and internal oblique muscles, associated with a disproportion between the protruded intestine and the constricting ring. This theory was accepted

by Cooper, Richter and others, but was denied by Scarpa, as well as by almost all later writers. Sharp, in 1750, called attention to the fact that nearly always the small intestine, and not the large intestine, was found in strangulated hernia, and as the content of the small intestine is liquid, strangulation was not due to an accumulation of hardened feces as claimed by the ancient writers.

Elastic strangulation or a disproportion between the hernial contents and the constricting ring, which is due to the forcing of more intestine into a sac of a hernia already obstructed, was described by Mauchart in 1722, and later by Wilmer in 1788, who observed that the ring was stretched by the descending intestine and later when it contracted, it produced strangulation. Goursaud, in 1768, stated that there were two causes of strangulation—obstruction and inflammation.

Adjuvants to Taxis in Strangulated Hernia.—Adjuvants to taxis in the treatment of strangulated hernia used by the ancients included antispasmodics, application of cold, sometimes warm baths or fomentations to the abdomen, opium, ipecac, etc.

Blood letting was popular in the 17th and 18th centuries, and tobacco enemas or smoke forced into the rectum by a bellows was used to produce a general depression, weak pulse, nausea, cold sweats and fainting. This condition was believed to aid taxis. A number of cases of fatal poisoning from the tobacco are recorded in the literature by the older writers.

Malgaigne wrote at length on the rôle of inflammation in strangulation. Following the work of Riolan, Dionis, Petit, de Garengéot, Scarpa, Cooper, and others, the cause of strangulation was generally believed to be a constriction by the hernial ring, despite the fact that Saviard, and later Arnaud, maintained that the constriction was in the neck of the sac.

Sabatier, in 1774, described the indications and operation for artificial anus in strangulated hernia. Louis, in 1781, published an excellent review of ancient operations as well as those in use for strangulation at that time. De la Peyronie, in 1743, after stretching the hernial ring with the fingers, sutured the intestinal ends together in certain cases. The wound was left open. Up to the end of the eighteenth century, many of the leading physicians and surgeons accepted most of the teachings of Hippocrates, Celsus, Galen, Paulus Ægineta, Rhazes, Albucasis and Avicenna.

(For additional details, see the historical introduction and the chapter on history of inguinal hernia.)

Anatomy

The anatomical structures affected by strangulation are the coverings of the hernia, the hernial sac, and its contents. Sometimes pathological complications in the abdominal cavity also occur, such as retrograde strangulation, perforation, hemorrhage, and volvulus of the omentum, intestine or mesentery.

Causes of Strangulation

Strangulation is due to a constriction that presses on the sac contents and obstructs their blood supply. This constriction is nearly always exerted by one of the hernial rings. Strangulation by the neck of the sac alone is infrequent, and intrasaccular strangulation, due to adhesions or constriction in the sac wall, or to a torsion of the hernial contents, is still more uncommon.

1. Strangulation by the Hernial Ring.—Strangulation by the hernial ring, or extrasaccular constriction, is found in a large majority of strangulated hernias. The constricting point consists of fibrous tissue or fascia, such as Gimbernat's ligament in femoral hernia, and the external inguinal ring in inguinal hernia. The hernial ring is usually small, rigid and unyielding, and sometimes it presents a sharp edge as in the case of Gimbernat's ligament. In small inguinal hernia, strangulation is often due to a small resistant external ring. After the ring enlarges and its pillars become weakened and thinned out, strangulation is comparatively rare.

2. Strangulation by the Neck of the Sac.—Constriction by the neck of the sac is infrequent and modern writers attach little importance to it. The neck of the sac is narrow and cannot be dilated, as it is held by the walls of the hernial canal. The older surgeons believed that strangulation was caused by the neck of the sac, which was found to be thickened, and often narrowed by fibrous or inflammatory adhesions that were due, as a rule, to the pressure of a truss or to other trauma; this is true especially in inguinal hernia, when the neck of the sac is compressed between the truss pad and the pubis. In adults with congenital inguinal hernia, there are often sharp constricting bands at the mouth of the sac. Blakeway stated that strangulation by the neck of the sac in adults is more frequent than is generally supposed.

3. Strangulation by the Hernial Ring and the Neck of the Sac.—In rare instances, strangulation is due to the pressure exerted by both the hernial ring and by the neck of the sac. The hernial ring is the primary cause of strangulation, but even after it is divided, the hernia cannot be reduced until the thick, resistant neck of the sac is opened up to the internal ring. When these two structures jointly produce strangulation, it is usually in subjects with inguinal or femoral hernia of long standing, who have persevered with truss treatment.

4. Strangulation from Other Causes.—Unusual causes of strangulation are as follows: (1) A diverticulum in the sac, especially in umbilical hernia; (2) constriction from bands of the cribriform fascia in femoral hernia; (3) constriction from intrasaccular adhesions in voluminous hernias; (4) constriction by the omentum, which presses on a loop of intestine, or else becomes inflamed and adheres to the sac wall in such manner as to narrow the lumen of the neck of the sac; (5) constriction from an adherent appendix, from a Meckel's diverticulum, or an epiploic appendix in the hernial sac; (6) strangulation due to volvulus or torsion of the sac contents; (7) constriction by an opening in the mesentery or omentum through which a loop of intestine passes; (8) retrograde strangulation.

5. **Strangulation from External Causes.**—In rare instances, strangulation may be due to conditions outside of the hernial canal and sac, such as constriction produced indirectly by tumors, inflammation, etc. Pfister reported the



Fig. 3.

Fig. 3.—Retrograde strangulation. The portion of intestine between the two loops remains in the abdominal cavity.

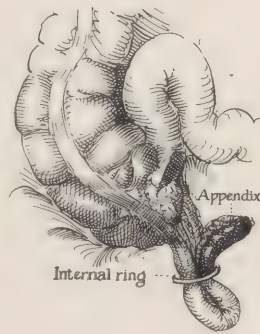


Fig. 4.

Fig. 4.—Retrograde strangulation of the distal portion of the appendix.

case of a man with strangulated femoral hernia complicated by enlarged lymph glands in the femoral region. As soon as the glands were excised, the hernia was easily reduced. I have observed a similar case.

Retrograde Strangulation (Hernia in "W"; Double Loop Hernia; Maydl's Hernia).—In retrograde strangulation the sac contains two loops of intestine. The portion of intestine between the two loops remains in the abdominal cavity. (Fig. 3.) This form of hernia was termed *hernia in-W*, by Maydl. Laroyenne observed a case in which the third or connecting loop was six feet (2 meters) long. Retrograde strangulation of the appendix or Meckel's diverticulum is very infrequent. When it occurs the gangrene is usually limited to the distal portion which lies in the abdominal cavity. (Fig. 4.)

Pathologic Changes of the Hernial Sac

In strangulation the hernial sac presents a tense, globular mass with its peritoneal surface edematous and congested. In neglected cases when the gangrene of the bowel is extensive, the sac may also be involved. Cases have been observed in which the sac was gangrenous and the intestine viable.

Very rarely the sac may rupture spontaneously, or as a result of taxis. A neglected abscess of the hernial sac will perforate the sac wall and its coverings, drain externally, and finally terminate in a fecal fistula.

Fluid in the Sac.—If the obstruction in the blood supply is incomplete, only the venous circulation is impeded, with the result that there is an effusion of serum into the sac. This serum is at first limpid, clear and lemon-colored, but as the venous stasis increases, there is a migration of red blood cells through the walls of the mesentery and intestine, that changes the color to a light red or brown, and if taxis has been employed, considerable blood may extravasate into the sac, turning the serous exudate dark brown in color. The fluid is at first sterile and contains flakes of fibrin, but later, when colon bacilli and other bacteria pass through the intestinal wall, it becomes turbid, has a foul fecal odor, and sometimes contains gas. On account of the lowered vitality of the hernial contents, the virulence and proliferation of bacteria in the strangulated loop are rapidly increased.

Pathologic Changes in the Intestine.—The changes in the intestine are of the greatest importance because the treatment and prognosis depend upon them. The amount of intestine strangulated is usually small. In fact, small hernias are more subject to strangulation because their hernial ring is narrow. The length of the strangulated loop in femoral hernias rarely exceeds six to twelve inches (15 to 30 cm.), and in inguinal hernias, twelve to twenty-four inches (30 to 60 cm.). When only a portion of the intestinal caliber is strangulated, the hernia is known as a partial enterocoele, or a *nipped* hernia, or Richter's hernia.

The following pathologic changes occur in strangulated intestine: (1) Congestion; (2) inflammation; (3) ulceration and gangrene.

1. Congestion.—In the beginning of strangulation the intestine is bright red in color, and the turgescient veins are distinctly seen under the serosa of the intestine and in the mesentery. As the congestion increases the intestine grows darker in color, either bluish-black or purple. It becomes distended, as a result of increasing intraintestinal pressure, and may attain twice its normal size. The serosa usually remains shiny throughout the stage of congestion, although the intestine and mesentery show signs of beginning edema. The intestine will bleed if it is pricked.

2. Inflammation.—As the venous stasis increases and the constriction gradually cuts off the arterial supply, the congestion is replaced by ecchymotic spots on the intestine, which gradually spread to all of the constricted loop. The edema increases, the smooth, glossy serosa becomes rough and dull, and there is a fibrinous exudate which sticks to the fingers. The lowered vitality of the intestine favors the migration of bacteria through the intestinal wall, and infection of the sac cavity is followed by inflammatory processes involving the sac wall and other contents.

The intestinal mucosa is swollen, injected, and often presents membranous patches of serous exudate, which cover ulcers of the mucosa. The effects of

inflammation are most pronounced at the point where the neck of the sac is constricted; often a distinct furrow can be seen here, and the ecchymosis is more marked than further down on the convexity of the loop. The intestine has lost its tone, it feels thin and is very friable. If the constriction is relieved at this stage, the viability of the intestine is so low that ulceration and perforation often occur in spite of the restoration of circulation and color in the strangulated loop. When intestine of such questionable vitality is returned to the abdominal cavity, abdominal peritonitis develops within a few hours or days.

3. Ulceration and Gangrene.—Ulceration and gangrene are closely associated. Ulceration nearly always develops first, at the point where the intestine is directly under pressure by the constriction. On account of the vascularity of the mucous membrane, it is the first to suffer from the effects of strangulation, and ulceration may involve a portion of it or its entire thickness. The circular muscular fibers are the next to yield, and then the longitudinal fibers give way. The resistant connective tissue fibers outlive the muscular layers, but become ulcerated before the serosa is cut through. The furrow caused by the constriction is deepest, and the ulceration most marked at a point opposite the sharpest and most unyielding part of the constricting ring. In femoral hernia, the ulceration nearly always appears first at the point where the neck is constricted by the thin edge of Gimbernat's ligament, as though the intestine were broken on its own edge.

The effects of strangulation are not the same for all parts of the strangulated loop, but are most marked at the point of constriction, and at the upper part of the proximal end of the loop. The latter point is drawn against the ring by the distended intraabdominal intestine, and also by the tense loop in the hernia.

Gangrene may occur as early as five or six hours after the onset of the first symptoms of strangulation. It appears earliest in strangulated femoral hernia. The intestine loses its luster, and has a deep purplish, ashen gray, or dead-leaf color. The color of strangulated intestine is due to the coloring matter of the blood, which, as it decomposes, changes to various shades of brown or green. If the tissues were not discolored by blood, all gangrenous intestine would be white.

The necrotic area may be only a small point on the bowel wall or it may involve a portion of the circumference, and in severe cases, the entire loop is gangrenous. In the early stage of gangrene, before perforation, the intestine retains some of its firmness and distention; as the necrosis extends the intestine collapses, often lying in folds, and the walls feel soft and are very friable. J. D. Sala, writing in the 16th century, remarked that gangrenous intestine tears like wet paper. The gangrenous loop has a much lower temperature than living tissue. Sometimes the peritoneal coat remains intact, while the underlying muscular and mucous coats are destroyed. The serous, muscular, and mucous layers are separated from each other by collections of dark brown or blackish serum, or by circumscribed hemorrhagic areas.

In the beginning, nonperforated gangrenous intestine has a cadaverous odor which gradually becomes foul or fecal, as the bacteria in the lumen penetrate the intestinal wall. When perforation takes place, the contents of the loop invade the hernial sac and the inflammation that follows extends to the coverings of the hernia, and if the patient lives long enough, the enlarging abscess breaks through and forms a fecal fistula. Occasionally the infection breaks down the protective adhesions at the abdominal ring, enters the peritoneal cavity, and terminates, as a rule, in a fatal peritonitis.

If left untreated, the gangrenous loop separates from the viable intestine, and usually comes out in shreds through the fecal fistula opening. In rare instances, it comes out in one piece. In the Museum of Guy's Hospital, London, there is a specimen of intestine five and one-half inches (13.75 cm.) long, that was extruded through the hernial wound a week after incision for drainage.

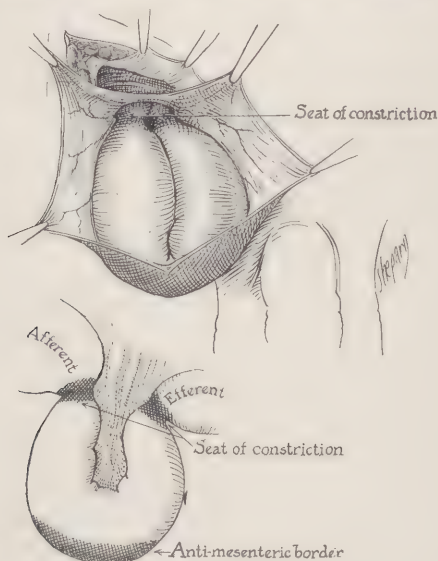


Fig. 5.—Gangrene and perforation of the intestine. When the strangulated loop is pulled down, a groove or furrow can often be seen at the point of constriction.

Fig. 6.—Gangrene and perforation occur most frequently at the convexity of the loop, on the anti-mesenteric border, and less often at the point of constriction.

Site of Perforation.—Perforation most frequently occurs at the convexity of the strangulated loop. In 25 cases observed by Reichel, perforation occurred at the point of constriction 4 times; 9 times at the convexity of the loop; 7 times at both the convexity and the point of constriction; and the whole loop was gangrenous 5 times. (Figs. 5 and 6.)

The Contents of the Strangulated Loop.—When the strangulated loop consists of small intestine, the usual contents in the beginning are a small amount of gas and a lemon-colored serous fluid which is secreted by the mucous membrane and its glands. As the strangulation continues the contents become thickened, often to the consistency of mucus, and are reddish-brown in color,

from hemorrhagic oozing from the intestine. Fecal matter is very seldom found in strangulation of the small bowel, but is often a part of the intestinal contents when a loop of large intestine is strangulated, especially if it is descending colon or sigmoid. When bacteria invade the contents of the strangulated loop, the fluid becomes septic and has a foul fecal odor.

The Strangulated Mesentery.—The changes in the mesentery are similar to those that take place in the intestine. The mesentery is swollen and congested with numerous patches of ecchymosis. Often there are circumscribed hemorrhages between its layers, and the mesenteric vessels are usually thrombosed.

Separation of the Mesentery

Separation or laceration of the mesentery is a rare complication of hernia, only a few cases being recorded in the literature. The separation occurs between the intestinal border of the mesentery and the intestine, and according to Rabère and Charbonnel, it is nearly always due to traction on the mesentery. The tear may be small, one-half to two inches (1.25 to 5 cm.), or it may be extensive. In the case reported by Gallo, the mesentery had separated for a distance of thirty inches (75 cm.). Very rarely the separated mesentery may retract into the abdominal cavity.

The last part of the ileum is the portion of the intestine usually involved. In a study of the cases reported in the literature, separation most frequently occurs on the right side, and inguinal and femoral hernia are about equally affected.

Etiology.—The etiology of separation of the mesentery is unsettled. The following are predisposing factors: Friability of the inelastic mesentery, gangrene of the mesentery, overdistention of the intestinal loop in the sac, and a sac of voluminous proportions that fails to hold the intestinal loop in contact with the rigid mesentery. The active cause is probably always mechanical traction, which pulls the intestine loose from the mesentery. While most of the cases reported in the literature have followed attempts at taxis, there are several cases discovered at operation, in which taxis had not been employed. In Lecène's patient, the separation was thought to have been caused by violent straining, as no preceding taxis had been employed. As a rule, the sac is found filled with bloody fluid. In rare instances, when complete mesenteric thrombosis precedes the separation, there is no hemorrhage; Fiolle reported a case of this kind.

Prognosis.—The prognosis of separation or laceration of the mesentery is very grave. I have collected 13 cases in the literature and of these, 4 patients died following operation.

Treatment.—The treatment consists of making a V-shaped excision of the gangrenous mesentery; carefully ligating the mesenteric vessels to prevent secondary hemorrhage; resecting the intestinal loop, which has been deprived of its blood vessels; and anastomosing the ends of the healthy intestine. (See methods of intestinal anastomosis.)

Lesions of the Intestine in the Abdomen.—1. *Above the Constriction.*—The intestine that lies in the abdomen above the constriction (afferent loop) is edematous and dark colored from venous congestion, and the bowel above the obstruction is distended by gas and semiliquid contents. The peristaltic waves from the intestine above increase the tension. Sometimes the intestine just above the constriction is two or three times its normal size, and this distention may cause a paralysis of the muscular layers. In addition to the congestion of the peritoneal covering, the mucous membrane is edematous and ecchymosed, and may also be eroded in places.

2. *Below the Constriction.*—The intestine that lies below the constriction (efferent loop) is of normal size and color, and is empty. The portion lying in proximity to the constriction is more or less congested and suffers from disturbances in circulation, with the result that there is often an acute enteritis of the mucous membrane.

Frequency of Strangulation.—Strangulation occurs more often in irreducible hernia than in the reducible form. Of the four principal varieties, femoral hernia strangulates most often; umbilical is next in frequency; inguinal hernia does not strangulate often, and ventral hernia strangulates only rarely.

Mechanism of Strangulation.—The mechanism of strangulation has long been a subject of controversy, and many theories have been advanced to explain it. At the present time, many of these are simply of historic interest and space permits only the mentioning of them here:

The Obstruction Theory.—The oldest theory is probably strangulation by obstruction, described by Goursaud in 1768. However, this term was used by Covillard in 1639. Goursaud believed that the accumulation of intestinal contents became so great that the hernia could not be reduced, and thus the obstruction in the lumen of the intestine was the cause of strangulation.

Strangulation by Inflammation.—Malgaigne advanced the theory that inflammation was the cause of strangulation. He maintained that a majority of cases diagnosed as strangulated hernia were, in reality, inflamed hernia, and should be treated by palliative measures. He stated that between 1836 and 1841 he and his colleagues in Paris hospitals operated on 183 patients, and of these 62.2 per cent died. Of those between 50 and 80 years of age, 72.1 per cent died. This appalling mortality rate led Broca, in 1853, and others, to accept the theory of inflammation as a cause of strangulation, and to treat it expectantly, with the result that the mortality was still higher. We know now that inflammation is a sequel of strangulation and not its cause.

Spasmodic Strangulation.—The theory of spasmodic strangulation was mentioned by Dionis in 1698, and by Mauchart in 1722. According to this theory, strangulation was supposed to be due to a spasmodic contraction of the hernial ring, and in inguinal hernia there was also a spasm of the internal and external oblique muscles. Richter was one of the most prominent advocates of

this theory; Cooper also believed it, but it was denied by Scarpa, and nearly all later writers.

Experimental Theories.—Numerous experiments have been made in an attempt to explain the mechanism of strangulation, and while considerable light has been thrown on the subject, the conclusions arrived at do not explain every case, owing to the fact that experiments cannot be carried out on living human subjects.

O'Beirne's Experiment.—O'Beirne's classical experiment, in 1838, consisted in drawing an intestinal loop through a hole in a piece of cardboard and injecting water or air into the upper end of the loop. If the ring is as wide as the filled intestine, the fluid or air passes through the loop without hindrance; if the ring is smaller than the intestinal caliber, $\frac{2}{5}$ of an inch (1 cm.), the distention of the intestine inside of the abdomen draws the intestine lying in the sac through the ring into the abdomen. By repeating the experiment with a ring $\frac{1}{2}$ of an inch (2 cm.) in diameter, the fluid or air passes beyond the ring and distends the loop, but cannot pass into the abdomen. As the distention increases, more intestine is drawn into the sac from the lower end of the loop.

Roser's Experiment.—In 1856 Roser passed a loop of intestine through a hole about $\frac{2}{5}$ of an inch (1 cm.) in diameter. After distending the loop, he found that a small catheter could be passed through the hole along the side of the intestine, and if the latter were drawn aside, a free space could be seen in the hole, although no fluid passed out of the loop. Roser believed that the folds of the mucous membrane had a valve-like action at the point of constriction. While this theory does not explain strangulation, it throws some light on the mechanism of obstruction.

Busch's Experiment.—In 1875 Busch passed an intestinal loop through a small ring and distended it. He believed that the pressure was greater on the convex side of the bowel than on the concave side, and that this tends to straighten the loop, and draws the lower end of the bowel against the ring, producing obstruction.

Lossen's Experiment.—Lossen, in 1875, demonstrated that the afferent end of the loop is not closed, but remains in communication with the bowel above, while the efferent end of the loop is closed by the pressure of the distended afferent loop.

Berger's Theory.—Berger, in 1876, stated that after the intestine has entered the sac, the mesentery is drawn up into the abdomen, forming a conical plug, which occludes the ring.

Kocher's Theory.—Kocher, in 1877, found that sudden distention of a loop of intestine acts by drawing more bowel into the sac from the efferent end, and the increasing volume of mesentery drawn into the sac adds to the constriction of the intestine.

Reichel's Theory.—Reichel, in 1886, observed that the intestine in the sac is augmented by intraabdominal tension that forces more intestine into the afferent loop, while the pressure in the loop draws intestine into the sac from

the efferent end. As the amount of mesentery in the ring increases, the intestinal contents are obstructed, and the fluid and gas in the intraabdominal intestine above the afferent loop, draw this loop upward, producing an invagination of the mucous membrane, while the serosa is tightly held by the constricting ring.

Meyer's Experiment.—Meyer endeavored to determine the degree of constriction necessary to produce strangulation. While the size of the opening necessary to produce obstruction depends on the thickness of the intestinal walls, and the contents of the bowel, he found that an opening the size of a number 10 F. catheter always produces strangulation, and an opening the diameter of a number 12 F. catheter almost always produces obstruction.

Strangulation by Volvulus.—Strangulation by volvulus of the loop was described by Gatinaia in 1496, Pigray in 1692, Richter in 1785, and other early writers.

Elastic Strangulation.—The theory of elastic strangulation probably explains the mechanism of hernia in a majority of cases, better than any other theory. The sac may be empty previous to the onset of the attack, or if intestine or omentum is in the sac the amount is ordinarily small, and there are no signs of obstruction because the fibrous hernial ring is somewhat elastic.

As a result of sudden increase in intraabdominal tension, additional intestine or omentum distends the ring and enters the sac. When the pressure is removed from the hernial ring, it returns to its normal size and presses on the intestine or omentum that failed to return to the abdominal cavity when the increased intraabdominal pressure ceased. Peristalsis from above the constriction forces additional fluid and gas into the obstructed loop, and as the distention increases, obstruction in the blood supply develops in the mesentery and in the intestine inside the sac, and is aggravated by edema and swelling. This is the stage of congestion.

Bolognesi concluded from an experimental study, that it is difficult to produce strangulation by means of a rigid constricting ring, but it is an easy matter to induce it with an elastic ring. Ritter carried out a series of experiments on elastic strangulation, and concluded that the first stage of anemia and contraction of the loop is soon followed by relaxation, distention, inflammatory hyperemia and swelling.

Changes in Circulation Due to Pressure.—Van Zwalenburg studied the circulation in the wall of the living intestine under the microscope. The intestine was opened, an electric light bulb inserted, and a cannula tied in the incision. By forcing water through the cannula to distend the intestine, some of the capillary streams were checked when the pressure reached 30 mm. of mercury. Many vein currents were stopped, and the individual corpuseles could be seen when the pressure reached 60 mm.; all circulation stopped at 130 mm. Ecchymosis developed early, at 50 mm. The intestine kept at a pressure of 80 to 90 mm. for an hour, became intensely congested.

Frequency of Strangulation.—Strangulation is the most frequent complication of hernia. In 10,000 cases of hernia studied by Berger, there was temporary irreducibility in 43; hernial peritonitis or inflammation in 58; and strangulation in 250.

Predisposing Causes

A. Sex.—Strangulation is most often encountered in males, because a large majority of hernias occur in them. However, the percentage of strangulation is much higher in females (14.06 per cent, Berger) in proportion to the number afflicted. In males the percentage is 3.61, according to Berger. In females pregnancy and obesity are important predisposing causes. In 225 cases of strangulated hernia in infants under 2 years of age, collected by Estor, 205 were in females, and in 15 the sex was not given.

B. Age.—Strangulation is most frequent in middle life and old age. It is rare in infants, infrequent in children, and seldom seen before the twentieth year, when it gradually begins to increase in frequency, reaching the maximum in males between the 40th and 50th years and in females between the 60th and 70th years.

In 120 of the cases collected from the literature by Estor, strangulation occurred during the first six months (40 in the first month); in 49, it occurred in the second half of the year; and in 54, it occurred during the second year. In infants the danger of strangulation is greatest during the first month of life, and steadily decreases thereafter. Estor estimated that the frequency of strangulation in infants and adults was 1 to 62, while Frickhöffer placed it at 1 to 107.

C. The Site of the Hernia.—The frequency of strangulation depends largely on the location of the hernia, certain varieties being very much more liable to it than others. Femoral hernias strangulate most frequently, 6.45 per cent in men, and 9.05 in women (Berger); this fact is due to the small fibrous ring and the sharp cutting edge of Gimbernat's ligament. Umbilical hernia strangulates next in frequency, and finally, inguinal.

According to Berger, the frequency is as follows:

	MEN	WOMEN	TOGETHER
Inguinal hernias in 100	1.34	2.16	1.43
Femoral " " "	2.03	9.02	6.45
Umbilical " " "	0.24	2.88	1.95

In Estor's series, 205 were inguinal, 14 umbilical, and 2 femoral.

D. Congenital Causes.—Congenital or preformed sacs are the principal predisposing factors of inguinal and femoral hernia, and are also the cause in a lesser degree, of other hernias. Other congenital causes are deficient muscular development, relaxed inguinal rings, malformation, etc.

E. The Size of the Hernial Ring.—Well developed hernias that have been controlled by a truss are more liable to strangulate than those that have been

neglected and have developed large hernial rings. When a truss is worn, the irritation of the pad produces an inflammation in the neck of the sac, causing it to become thickened and to contract; often the neck is narrowed still more by pieces of omentum becoming adherent to it.

V. Time of Onset of Strangulation.—Many hernias strangulate the first time they come down, especially femoral hernia. Of 239 cases of strangulated hernia studied by Berger, 48 strangulated the first time they came down; 89 strangulated within ten years of their onset; and 102 strangulated more than ten years after their onset.

Exciting Causes.—The active or exciting causes of strangulated hernia are the same as those that apply to the nonstrangulated varieties, namely, any factor that causes an increase in intraabdominal tension, such as a strain, a fall, trauma, whooping cough, bronchitis, etc.

Symptoms and Diagnosis

The symptoms of strangulated hernia are usually well defined, and diagnosis is easy. However, in the event that one or more of the characteristic symptoms or signs is absent, there may be considerable difficulty. The onset of strangulation is usually acute, ordinarily following an increase in intraabdominal tension, caused by lifting, a fall, a mis-step, etc.

As a rule, strangulation occurs in patients whose hernias are down or have been controlled by a truss. Sometimes the patient leaves off his truss from neglect, or from a belief that he is cured. However, strangulation is most often caused by the hernia slipping by the truss. Whether the hernia is already down or comes down suddenly, the patient notices a rapid increase in size and tension, as additional viscera are drawn into the sac, and congestion develops, followed by inflammation.

Functional Symptoms.—The most important functional symptoms are pain, nausea and vomiting, constipation, prostration and shock.

Pain.—There is almost always pain in the early stages of strangulation. It usually comes on suddenly, and is first noticed over the hernial ring. It is a sharp, griping pain, of an exacerbating character, and is due to peristaltic waves from above the obstruction attempting to overcome the constriction. There is nearly always a colicky pain over the abdomen, and often in the region of the umbilicus that comes on in paroxysms. As the strangulation increases the pain becomes more severe, and is continuous, perhaps causing the patient to double up.

The pain does not stop until the peristaltic contractions cease. Intestinal peristalsis is checked by the development of gangrene, the division of the constriction, or the administration of an opiate. The spontaneous cessation of pain is a grave symptom. It gives the patient a false sense of security. The operator may be led to delay operation, and the condition soon terminates in death.

Nausea and Vomiting.—There may be nausea without vomiting when only a portion of the lumen of the intestine is obstructed, as in partial enterocele,

hernia of the appendix, etc. Vomiting is perhaps the most important sign of complete obstruction or strangulation, and it comes on soon after the constriction of the intestine is complete. It occurs earlier when the obstruction is in the upper part of the intestinal tract, than when it is in the lower part of the ileum or in the large intestine.

In the beginning vomiting is projectile and purely reflex, and consists of the ejection of the contents of the stomach, duodenum, and the upper part of the jejunum. If the strangulation is not relieved, the vomiting gradually becomes more severe, the vomitus consisting of bile and intestinal contents with a fecal odor. At this stage the vomiting is due to reversed peristalsis, or to stimulation of the vomiting center by the toxic products of the strangulated loop. The vomiting is usually continuous, although it sometimes has periods of omission, and it persists until the constriction is divided or until death. In very rare instances, there is no nausea or vomiting even after the gangrenous intestine has ruptured into the sac.

Vaughan studied 25 cases of strangulated hernia and found that pain was present in all; vomiting occurred in 20; nausea without vomiting in 2, and in 3 there was no nausea or vomiting.

Constipation.—Constipation is complete when the entire lumen of the intestine is constricted. When the upper part of the small intestine is strangulated, a considerable amount of feces may be brought away by enemata, and in the beginning of strangulation this fact is liable to cause the inexperienced to make a diagnosis of partial obstruction. After the bowel below the obstruction is emptied, neither gas nor feces are passed by the rectum. When the strangulation involves the descending colon or sigmoid, there is sometimes an urgent desire to go to stool.

An enteritis of the bowel below the obstruction in the beginning of strangulation, may cause *diarrhea*, which stops after vomiting sets in. When only a portion of the lumen is obstructed, constipation is not complete, some gas and feces are passed by rectum, and in isolated cases, there may be diarrhea.

Prostration and Shock.—Prostration and shock are serious symptoms, and when they appear the outlook is grave. Prostration occurs early in infants, in young children, in the aged, and in those enfeebled from disease or from repeated attempts at taxis. The onset of prostration and shock are apparent in the appearance of the patient. The face is pinched and has an anxious expression, sometimes called the *facies abdominis* by the older writers. The eyes are sunken, dull and lusterless; the skin cold, clammy and moist, and the breathing is labored, rapid and shallow. The skin is cyanotic, the lips blue, and the tongue dry and heavily coated. The pulse at first rapid, gradually becomes slow, weak and easily compressible, and the temperature, often elevated in the beginning, gradually falls to subnormal. There is often tympanites when the obstruction is low down in the intestine; the distention is pronounced, and it is still more marked if there is a complicating abdominal peritonitis. The urine is scanty or suppressed in advanced strangulation. Hiccough usually

appears later and may be associated with other terminal symptoms, such as muscular cramps, tremors, coma and delirium.

The graphic description of the symptoms of strangulation written by Aretæus, in the second century A.D., remains a classic today, and has never been excelled by any author.

Objective Signs.—In strangulation the hernial mass is painful, tense and irreducible, and yields no impulse on coughing. It is sometimes fluctuating and is usually dull on percussion. No sound is heard on auscultation.

In rare instances there are no objective signs in very small hernias in obese subjects, in interparietal hernias, and in hernias that have reduced *en masse*. Muller has written at length on this subject.

1. *The Hernial Swelling.*—There is an irreducible mass at one of the hernial openings that has usually been reducible previous to the onset of the strangulation. There is pain over the tumor, especially in the region of the constricting ring, which is continuous, sometimes of a burning or cutting character, and is aggravated by manipulation or attempts at taxis. There is also tenderness on pressure. In the beginning of strangulation the irreducible swelling increases in size, owing to additional viscera being drawn into the sac, and to an accumulation of fluid in it. The tension gradually increases and the viscera cannot be palpated. If arterial and venous strangulation occur suddenly and at the same time, the tenseness is often not marked.

2. *Palpation.*—On palpation the tumor is hard and resistant. When the patient coughs no impulse is detected in the mass, and when an infant cries, the expansile impulse is also lacking. There is often fluctuation in a strangulated hernia that has been of slow onset, and in which the sac contains fluid. Fluctuation is absent when the sac is very tense or when there is only a little fluid in it.

3. *Percussion.*—Strangulated hernia is usually dull on percussion, owing to the presence of fluid in the sac or within the strangulated loop.

4. *Auscultation.*—In strangulated hernia no gurgling sounds over the tumor are audible.

5. *Strangulated Hernia Without External Swelling.*—Strangulated hernias that present no local signs of a tumor were called *masked hernias* by the older writers, and included obturator, sciatic, and small inguinal, femoral, and ventral hernias in which only a portion of the intestinal caliber was involved (partial enterocoele).

6. *Signs of Gangrene.*—In neglected cases of strangulated hernia, the general symptoms are those described under prostration and shock, while the local signs are: Edema and congestion over the hernia, often with a black area in the center; subcutaneous emphysema; cessation of pain; softness and shrinking of the tumor, and occasionally spontaneous reduction. Should the patient survive this period, the skin over the hernia nearly always ruptures and a fecal fistula forms.

7. *Strangulation as a Complication of Other Diseases.*—Strangulation may

develop as a complication of a more serious condition, and when the severity of the symptoms is out of proportion to the size of the hernia, some other intra-abdominal condition, such as a volvulus or a perforative peritonitis should be suspected. Failure to recognize and relieve the primary condition results in a continuance of the symptoms and usually in the death of the patient.

Murray reported a case of irreducible hernia accompanied by great shock, tympanites and severe pain over the lower abdomen. At operation fluid gushed out as soon as the sac was opened, although there was no strangulation. The abdomen was opened in the midline, and a tear one and a half inches (3.75 cm.) long was found in the duodenum.

Differential Diagnosis

1. **Partial Enterocoele.**—The symptoms of partial enterocoele are similar to those of complete enterocoele with the exception that vomiting is less severe; constipation is not absolute, and the other symptoms are also milder. The tumor is small, and for this reason partial enterocoele must not be confused with hernia of the appendix and hernia of Meckel's diverticulum. Because the symptoms are indefinite, diagnosis is difficult and often delayed, consequently the mortality is higher than in ordinary hernia.

2. **Strangulated Omental Hernia.**—The changes that occur in strangulated omental hernia have been described with those of hernia of the intestine with which it is usually associated. When omentum is alone in the sac, the symptoms are similar to those of strangulated intestine, but are much milder, and there is seldom colicky abdominal pain. Nausea and vomiting are not marked and may be absent. Constipation is not absolute. The local swelling is usually small, somewhat tender, irreducible and dull on percussion; sometimes the irregular lobules of omentum can be felt through the hernial openings.

3. **Other Conditions.**—Inflamed lymphatic glands must not be mistaken for strangulated hernia. The points in differential diagnosis are taken up in the chapters on inguinal and femoral hernia. It should be remembered that an abscess of a lymphatic gland sometimes overlies a strangulated hernia and conceals it.

Orchitis and epididymitis cause no confusion if a careful examination is always made of the inguinal canal and rings.

An undescended testis seldom causes confusion. There is no testis in the scrotum on the side of the suspected hernia. In rare instances, when the testis is in the inguinal canal near the internal ring, it may be impossible to exclude partial strangulation before operation.

Hydrocele of the cord in infants and young children is sometimes mistaken for strangulated hernia. In hydrocele of the cord the symptoms of strangulated hernia are wanting. The tumor is fluctuating, dull on percussion and translucent; however, translucency is of little value, as enterocoeles in infants and young children are often translucent.

The vomiting of pregnancy associated with irreducible hernia is not misleading if there is positive evidence of pregnancy and the other signs of obstruction are absent.

Prognosis

The prognosis of strangulated hernia is always serious. It is most favorable with infants and children, its gravity increasing as age advances. When omentum and intestine are in the sac together, the effects of the constriction are less severe and less extensive than when intestine alone is strangulated. In partial enteroceles the strangulated area is smaller than in complete enteroceles, but the prognosis is more serious on account of the onset of gangrene, which occurs earlier than in complete enteroceles, and the delay in operative intervention due to difficulties in diagnosis.

In suspected strangulation operation is the only treatment to be advised and it cannot be undertaken too early, as the mortality rate is directly proportional to the promptness with which the strangulation is relieved. The death rate of irreducible strangulated hernia, unrelieved by operation, is nearly 100 per cent.

The prognosis of strangulated massive hernias that have been outside of the abdomen a long time, and have lost their *right of domicile* is very grave. The increase in intraabdominal tension that follows the return of these viscera to the abdomen, is often the cause of fatal pulmonary or cardiovascular complications. (See chapter on umbilical hernia.)

The mortality rate for strangulated hernia has decreased very little in the last twenty-five years. This is largely due to the fact that the surgeon selects an operation that is beyond the recuperative powers of the patient, the after-treatment is not given sufficient attention, and general anesthesia is too often employed when the local method should be used. I believe that no substantial reduction will be shown in the mortality rates until local anesthesia is generally adopted as the anesthetic of choice for strangulated hernia operations.

Treatment

Immediate operation is the treatment of choice for strangulated hernia. As Stromeyer remarked nearly a century ago, if a case of strangulated hernia is seen in the day time, the patient should be operated on before the sun sets, and if it is seen in the night, he should be operated on before the sun rises.

Taxis.—Taxis was used by the ancients, and the technic was described in detail by William of Salicet in the 13th century. It is sometimes permissible to attempt taxis for strangulated hernia when the patient is seen within two or three hours after the onset of symptoms. It is more likely to be successful in infants and children than in adults, and for large hernias more than for small ones, and in inguinal and femoral hernias more than in umbilical hernias. Taxis should never be continued for more than five minutes and only a moderate amount of force should be used, even with the patient under anesthesia.

Inversion of the patient is sometimes helpful. The methods of taxis for the different varieties of hernia are described in their respective chapters.

Posture for Taxis.—There are certain postures that are an aid to taxis. Infants and children can be suspended by their feet, or slung up over the shoulders of an assistant while taxis is employed. A hot bath before this maneuver is often helpful; this was employed by the ancients, who also suspended the patient by the feet to facilitate reduction.

For adults, the following positions sometimes favor the success of taxis: The knee-elbow, knee-chest, Sims', and Trendelenburg positions with the knee bent. (Other positions for taxis are discussed under treatment, in the chapters on the different varieties of hernia.)

Contraindications to Taxis.—Taxis is contraindicated under the following conditions: (1) When the hernia has been down several hours; (2) when the onset is acute and the symptoms are severe; (3) when previous attempts at taxis have failed; (4) when the coverings of the hernia are inflamed or edematous; (5) when there are symptoms of prostration and shock; and (6) when there are signs of ulceration and gangrene.

Dangers of Taxis.—The principal dangers of taxis are: (1) Reduction of the hernia *en masse* with a persistence of the symptoms of strangulation; (2) rupture of the intestine; (3) contusion or laceration of the intestinal wall; (4) the reduction of gangrenous intestine into the abdominal cavity; (5) the forcing of infected sac contents into the peritoneal cavity; (6) the danger of ulceration and perforation of reduced intestine developing several hours or days after reduction; (7) the occurrence of intestinal hemorrhage, resulting from too forcible taxis; (8) incomplete reduction—the reduction of only part of the strangulated intestine into the abdominal cavity; (9) rupture of the sac near the neck and the subperitoneal reduction of the hernia; (10) the danger of tearing loose the constriction at the neck of the sac, and reducing it along with the intestine into the abdominal cavity; (11) the danger of failing to relieve the strangulation when the constriction is intrasaccular; (12) torsion of the loop persisting after reduction; and (13) intestinal paresis that often follows forcible or repeated taxis.

The possibility of strangulation being due to adhesion in the sac should be carefully considered before attempting taxis. There may be a very extensive adhesion that does not cause harm, while a very narrow band may produce obstruction. Even if the hernia can be successfully reduced, unless the constriction is relieved the symptoms will persist, and gangrene will develop, often with a complicating abdominal peritonitis.

Sanger reported 5 cases of rupture of the intestine due to taxis, and collected 35 additional cases from the literature. In 29 of these the variety was stated; 20 were inguinal and 9 were femoral. In most of the cases the hernia had existed for a number of years before strangulating. Twenty-two of the patients were operated on; 10 recovered and 12 died. Only one was free from peritonitis at the time of operation. All of the patients not treated by operation died of peritonitis.

Reduction en Masse

(*Reduction En Bloc; Displaced Hernia*)

Reduction *en masse* is the reduction of a strangulated hernia without relieving the constriction of the intestine. It was described by Saviard in 1702, by Le Dran in 1731, and more thoroughly by Richter in 1785.

Varieties.—There are three varieties of reduction *en masse*: 1. Properitoneal reduction: The strangulated intestine is reduced into an empty loculus of a bilocular sac. 2. Interstitial reduction without rupture of the sac: The sac containing the strangulated viscera is dislocated upward between the layers of the abdominal wall. 3. Interstitial reduction with rupture of the sac: The sac ruptures and the intestine is displaced to a position between the layers of



Fig. 7.

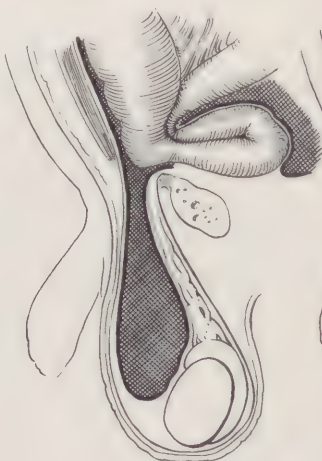


Fig. 8.

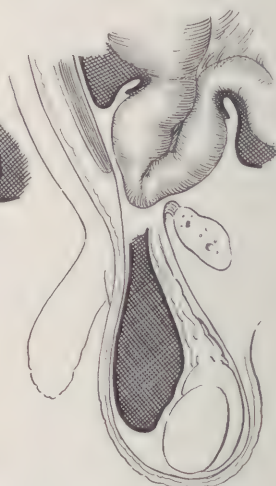


Fig. 9.

Fig. 7.—Reduction *en masse* following taxis. The hernial sac and contents have been reduced into the abdominal cavity.

Fig. 8.—False reduction *en masse* following incomplete rupture of the sac. The intestine is forced into the extraperitoneal tissues. Part of the sac remains in the scrotum.

Fig. 9.—False reduction *en masse* following complete rupture of the sac below its neck. The strangulation at the neck of the sac still persists. A portion of the sac is in the scrotum.

the abdominal wall, the strangulation at the neck of the sac remaining unrelieved.

Etiology.—As a result of manipulation or taxis, the sac is freed from the subcutaneous tissues, the constricting ring dilated, and the hernia displaced to a position beneath the peritoneum inside of the internal abdominal ring. The point of strangulation is in the neck of the sac. Sometimes the reduction *en masse* is the result of the patient's attempts to reduce the hernia. When a patient tries to reduce his own hernia, or calls on his friends to help him, they use more force and apply it more carelessly than the physician. (Figs. 7, 8, and 9.)

When inguinal hernia in the aged is associated with an excessive amount

of extraperitoneal fat and relaxation of the peritoneum, reduction *en masse* may follow the gentlest degree of taxis.

Age, Sex and Site.—Reduction *en masse* occurs most frequently between the 30th and 60th years, nearly always in males, and it is most common in the inguinal region.

Corner and Howitt collected in the literature 137 cases of reduction *en masse*. The ages in 100 cases were as follows:

10-20 years	5 cases
20-30 “	7 “
30-40 “	19 “
40-50 “	25 “
50-60 “	20 “
60-70 “	17 “
70-80 “	7 “

In 128 cases, the sex was divided as follows:

Males	110
Females	18

The location of the hernia was as follows:

Inguinal	113
Femoral	22
Obturator	2

In 68 subjects the hernia was on the right side, and in 39 it was on the left.

Duration of the Hernia.—The duration of the hernia before reduction *en masse* in 100 of the cases collected by Corner and Howitt was as follows:

DURATION	PER CENT
24 hours	8
1 year	2
1-2 “	2
10-15 “	15
Over 30 years	18

Frequency.—A majority of the cases of reduction *en masse* reported in the literature were found at autopsy, or were reported in the days when taxis was always attempted before resorting to operation. In the last ten years only a few cases have been recorded, a fact which is due, no doubt, to the general abandonment of violent taxis, and to the earlier recourse to operation. In 12,000 cases of hernia operations collected from hospital records by Eliason, there were no cases of reduction *en masse*.

Symptoms and Diagnosis.—On palpation the hernial ring is found to be enlarged, and often a tense globular mass can be felt just beyond the ring. There is fullness and tenderness of the lower abdomen on the affected side. Reduction *en masse* is followed by an aggravation in the symptoms of strangulation; the pain is more severe, the vomiting more frequent, abdominal tympanites is increased, and the diagnosis is reasonably certain. Whether the hernia has been reduced by simple taxis, or by division of the constriction and reduction, the persistence of the symptoms of obstruction demands immediate operative intervention.

Bookman observed 2 cases of spontaneous reduction *en masse*. Both patients gave a history of previous hernia, which led to a tentative diagnosis of strangulated reduction *en masse*. Ogilvie reported a case in which an inguinal hernia had been “successfully” reduced by taxis. Six months later strangulation occurred in the reduced sac, and at operation a hernia reduced *en masse* was found.

Prognosis.—The prognosis for reduction *en masse* is grave and the mortality rate is high.

In the 137 cases collected in the literature by Corner and Howitt the outcome was as follows:

VARIETY	MORTALITY RATE <i>per cent</i>
Inguinal	48
Femoral	72
Obturator	100

Treatment.—When operating for a suspected hernia reduced *en masse*, a midline or lateral rectus incision should be used, especially if the hernia is of the femoral or obturator variety, or if there is a history of double hernia or two hernias of different types. There are cases on record in which operation showed strangulation at a site where a hernia was not known to exist. Sometimes a large inguinal hernia will cover up a small femoral hernia which reduces *en masse* when the voluminous inguinal hernia is reduced. With the midline or lateral rectus incision, each hernial ring in turn is examined from within the abdomen. At the site of the strangulation, a firm, globular mass of variable size is felt, and often the two portions of the intestine can be recognized at the point where they enter the sac.

The constriction is divided. By gentle traction the strangulated loop is withdrawn into the abdominal wound and dealt with as in ordinary strangulated hernia. A herniorrhaphy is done if the general condition of the patient is good; otherwise the repair of the hernia is left for a later time.

Complications.—The complications following reduction *en masse* are the same as for ordinary strangulated hernia.

Severe intestinal hemorrhage sometimes occurs as a result of the trauma

incident to reduction *en masse*. This hemorrhage often does not appear for one to two weeks after the operation, as in the case reported by Harrison.

Savariaud reported a case of reduction *en masse*, which was later relieved by operation, but death resulted from a paralytic ileus that was due to violent taxis. The injury caused by the taxis was apparent at operation, the intestine being discolored in spots, and the mesentery ecchymotic.

Advantages of Operating without Preceding Taxis.—The advantages of operating without preceding taxis are generally recognized, and the low mortality rate is the best argument against taxis. Van Assen reported 100 cases of obstructed and strangulated hernia in patients who were operated on without preceding attempts at taxis. In this series there were only 2 deaths, and both of these patients were in a critical condition when first seen. I believe that these excellent results were partly due to the fact that local anesthesia was employed in 62 cases.

Medical Measures in Strangulation.—Gil y Ortega stated that when the duration of strangulation was not over eight to ten hours, reduction often followed the administration of small doses of caffeine, frequently repeated to stimulate peristalsis. Brix stated that the freezing of the skin over the hernia was often followed by spontaneous reduction, if the strangulation was recent. The application of ether compresses has been used to aid taxis. Hagen injected atropin over the site of the tumor and proceeded with gentle taxis. Three doses of atropin are given, and if not successful in six hours, operation is resorted to. All of these methods are to be vigorously condemned, as they are hardly ever successful.

THE OPERATIVE TREATMENT FOR STRANGULATED HERNIA

The Anesthetic.—As a rule, local anesthesia is the anesthetic of choice for the operation of strangulated hernia. Patients with strangulation are always poor operative risks because of their lowered vitality, shock and prostration being more or less pronounced in every case. The patient's recuperative powers are impaired by the toxic products of the strangulated loop, and when intestinal resection is necessary the prognosis is always grave, even under the most favorable conditions.

The dangers of general anesthesia for strangulation are well known, and statistics show that postoperative complications, such as acute dilatation of the stomach, pulmonary, nephritic and cardiovascular lesions, are much more frequent than when local anesthesia is used. With general anesthesia, the operation should be completed as quickly as possible, and the narcosis should be light. It is better for the patient to move a little during the operation than to be too deeply asleep.

Preoperative Treatment.—The patient should be well wrapped, and protected from undue exposure while being taken to the operating room. To minimize shock as far as possible, the operating table should be thoroughly

warmed by hot water bottles or electric pads, and the patient should be kept warm throughout the operation.

The Instruments.—Only a few instruments are necessary for the operation for strangulated hernia, but a liberal assortment is an advantage in that it saves considerable time, and often permits the carrying out of a slight modification of the routine operation, perhaps increasing the patient's chances of recovery. The necessary instruments are, a pair of scissors, scalpel, two pairs of tissue forceps, six or eight pairs of hemostats, two retractors, a needle holder, a grooved director, straight and full curved round needles, and cutting-edged needles. Sutures should include plain and chromic cat-gut and linen or silk thread. Two Murphy buttons of different sizes should also be provided.

In emergency, a safety-razor blade makes a very good scalpel, and retractors can be improvised by using bent spoons, or by passing a long thread through the flap that is to be retracted, and attaching a hemostat to it for a weight, or having a bystander hold the thread. Intestinal clamps covered with rubber tubing are sometimes needed, but if necessary the intestine can be tied off with a piece of narrow bandage passed through a small opening in the mesentery.

The Operation.—The operation for strangulated hernia is usually an emergency operation, and often has to be performed in the patient's home under unusual difficulties. Every physician should be able to perform it as a life-saving measure. Only a fair surgical knowledge is required; only ordinary instruments are needed, and if the simple operative procedures are carried out under local anesthesia, the mortality should be comparatively low.

The common mistake in operating on strangulated hernia is an attempt to do too much. It should be remembered that the object of the procedure is to save the patient's life, and a two-stage operation is better than a dead patient.

Kelotomy.—The older surgeons used the term "kelotomy" or herniotomy to describe blind division of the constriction. Often the finger was used as a guide for the location and division of the stricture, and several instruments were in use for this purpose. Méry invented a winged sound; Vidal constructed a channeled spatula; Huguier devised a boat sound; LeDran employed a grooved director with a concealed cutting blade, like a urethrotome; Morand used a sound with a hinged bistoury attached; Petit designed a hernial bistoury, which was later modified by Cooper. Cooper's herniotome, which is a curved, narrow-bladed scalpel with a sharp cutting edge and a blunt point, is used by some, at the present time. On account of the fear of peritonitis, the sac was rarely opened until recent times.

The Radical Operation.—Operation for strangulated hernia differs from the operation for nonstrangulated hernia, chiefly in the treatment of the constricting ring, and in the management of the contents of the sac. (For

the detailed technic of the operation for nonstrangulated hernia, see the chapters on special hernias.)

In general, the operation for strangulated hernia may be described as follows:

1. **THE INCISION.**—The incision is made over the center of the tumor, usually in its long axis, and is longer than for simple hernia. The subcutaneous tissues and fat are divided, bleeding vessels ligated, and the sac exposed and separated from adhesions for some distance on each side of the wound. Sometimes the tissues are swollen, discolored, and edematous, and it is necessary to divide them cautiously. The sac can be recognized by its gray or purplish color.

2. **OPENING THE SAC.**—The possibility of a sliding hernia of the intestine should always be excluded before the sac is opened, so that the bowel wall will not be incised in mistake for the sac. The serous covering of the intestine is smooth and glistening, and if it is examined carefully, it is seldom mistaken for the sac.

The sac is opened at a point as high as possible, where it is not adherent to the underlying viscera. It is picked up with two mouse-toothed tissue forceps or hemostats, and carefully opened between them with a scalpel or a pair of scissors. The incision is enlarged, and some fluid is ordinarily found in the sac. If this fluid is a clear serous exudate, it usually means that the changes in the intestine are not far advanced; if it is dark red or brown, and has a fecal odor, gangrene has developed.

The strangulated loop of intestine is located. If the hernia is very small, precaution must be taken to prevent the loop from retracting into the abdomen when the constriction is relieved. Should the loop slip into the abdomen, the intestine must be drawn back into the wound, and examined. This accident is to be guarded against, especially in enterocele. The strangulated intestine is covered with compresses or towels wrung out of hot (115° F.) sterile water or saline solution, while the constriction is being located and relieved.

3. **DIVISION OF THE CONSTRICTION.**—At the present time, strangulated hernia is always treated by the open operation. The incision in the sac is carried up to the constriction, which is exposed by retracting the edges of the wound and displacing the contents of the sac downward or to one side. The constriction is cautiously divided in plain view by nicking it with a scalpel or pair of scissors, the intestine being protected by the index finger or a grooved director. Often time will be saved by opening the peritoneum an inch or two (2.5 or 5 cm.) above the constriction, and dividing the latter on a director or on the index finger.

If the hernia is large and omental adhesions are extensive, additional constricting bands should always be looked for in the sac, and the possibility of a bilocular sac, as well as the presence of a second strangulated hernia in another region should be thought of.

Divulsion of the Ring.—Doyen believed that it is often easier to divulse the constricting ring, by means of a pair of long-bladed forceps, than to cut it.

4. EXAMINATION OF SAC CONTENTS.—The intestine is drawn into the wound and carefully examined.

a. *Signs of Viability.*—The intestine is usually viable when its color returns promptly after division of the constriction, or after the application of hot compresses for 15 to 30 minutes. Other signs of viability are: Absence of clotting in the mesenteric vessels; the presence of arterial pulsation; bleeding, when the mesentery is incised at different points, even though arterial pulsation is absent; and a smooth and glossy appearance of the intestinal serosa.

b. *Signs of Gangrene.*—The intestine is usually gangrenous if the color does not return; if the mesenteric vessels are thrombosed; if there is no arterial pulsation and no bleeding when the mesentery is incised; when the intestine is rough, lusterless, has lost its polish, is collapsed and feels like wet paper, or when it is thin and friable and feels as though it would break if it were bent.

Before returning the viable loop to the abdominal cavity, it should be drawn down, and the entire intestine examined for a distance of a few inches above the constriction for raw spots, ulcerated areas, and minute perforations. The groove caused by the constriction is usually deepest on the posterior surface of the intestine where the pressure has been greatest, and this area is inspected carefully. The vessels of the mesentery are examined for pulsation; if it is absent or if there are thrombotic areas, it is unsafe to reduce the intestine, as it will not survive.

Congestion Due to Traction.—If the color does not return to the intestine, it is sometimes due to traction on the mesentery. To exclude the possibility of this cause, the intestine is held for a few minutes near or within the peritoneal opening, so that the mesentery lies loose and is free from tension. When the intestine is viable, the circulation quickly returns.

Leaving Suspicious Intestine Outside of the Wound.—If the pulsation in the vessels is very feeble and the color improves only slightly with the application of hot compresses, the viability of the intestine is doubtful, and it is sometimes advisable to leave the suspected loop in the wound and cover it with warm, moist, vaselined sterile dressings, for a period of 12 to 24 hours. If the color does not return under this treatment, the intestine is gangrenous; if the color returns, the loose plastic adhesions can be readily broken down and the intestine replaced in the abdominal cavity without anesthesia, or, after a simple local anesthesia infiltration of the muscles and skin, the intestinal serosa being insensitive.

When intestine of doubtful viability is returned to the abdominal cavity, it should be covered with a piece of omentum whenever possible, as a precaution against postoperative perforation. In certain instances it is advisable to make a stab drain directly over the site of the intestinal loop.

The Omentum.—When the omentum accompanying the intestine is in good condition, it should always be returned to the abdominal cavity. Statistics show that omental resection adds slightly to the mortality rate in both strangulated and nonstrangulated hernia operations. When the omentum is inflamed, strangulated or irreducible, it should be resected by multiple interlocking ligatures, each bite including not more than one-quarter of an inch (6 mm.). If the omentum is extensively adherent to the sac, considerable time will be saved by ligating it at the neck of the sac, without attempting to separate the adhesions, and removing the adherent omentum along with the sac.

Ligation of Mesenteric Vessels.—I want to emphasize the importance of freeing the mesenteric vessels from all other tissues before ligating them to avoid leaving masses of necrotic mesentery, which are liable to become infected and suppurate. When the omentum is irreducible, on account of a small hernial ring, it can sometimes be returned to the abdomen if the neck of the sac is first freed all the way around for a distance of one-half to one

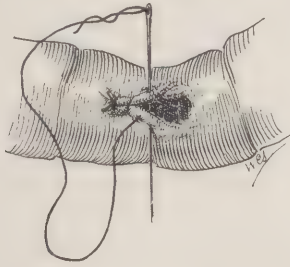


Fig. 10.—Inversion of a small, circumscribed gangrenous area. If the intestine has perforated, a second row of sutures or an omental flap should be used to reenforce the suture line. This method is not suitable when the gangrenous portion exceeds $\frac{1}{2}$ inch (1.25 cm) in diameter, on account of the danger of postoperative stenosis of the intestine.

inch (1.25 to 2.5 cm.) inside the internal ring. If this maneuver fails, the omentum should be ligated in sections, with each ligature at a different level; otherwise it may be difficult to return the omental stump to the abdominal cavity.

It is better to excise the omentum in multiple ligations than in a mass ligature, so as to preserve the spreading relationship to the intestines, and also to lessen the danger of embolism and thrombosis.

5. TREATMENT OF GANGRENOUS INTESTINE.—The treatment of gangrene depends on the amount of intestine involved, and the condition of the patient. If the gangrenous area is small, one-half inch (1.25 cm.) or less, it can be inverted into the intestine and the healthy serosa sutured over it (Fig. 10); if it is long and narrow, and most of the circumference of the intestine is involved, the necrotic strip can be invaginated into the lumen of the intestine and the healthy layers of serosa sutured together, producing a partial intussusception. A piece of omentum, when available, should be tacked over the suture line.

When gangrene is extensive, there are two methods of treatment: Immediate primary resection of the gangrenous intestine, and the formation of an artificial anus.

Primary Resection.—Primary resection of the intestine is the treatment of choice, and should always be employed when possible, as both the immediate and late mortality rates are lower with it than with the artificial anus operation. When the strangulation is high up in the small intestine, resection is almost imperative, because if an artificial anus is made, the patient soon dies from inanition unless the opening is promptly closed by a second operation.

The three principal methods of resection that are applicable to the treatment of strangulated gangrenous intestine are: (1) Anastomosis with the anastomotic button; (2) lateral intestinal anastomosis; and (3) end-to-end, or end-to-side anastomosis. When time permits, the method of choice is to close the divided ends and do a lateral anastomosis; end-to-side anastomosis is the second choice, and finally, end-to-end anastomosis is indicated when it is impossible to bring the intestine up into the wound. In cases of extreme urgency, the anastomotic button should be employed or an artificial anus should be formed.

Application of Intestinal Clamps.—A clamp with light elastic blades covered with rubber tubing, is applied to the intestine about two inches (5 cm.) above the proposed line of resection. The intestine, including the gangrenous area, is emptied of its contents as thoroughly as possible, and a second rubber clamp is applied to the intestine about two inches (5 cm.) below the proposed lower line of resection. An ordinary long-bladed forceps is applied at the upper limits of the gangrenous area, and another one just below the gangrenous area. These forceps prevent fecal extravasation when the gangrenous intestine is cut away.

The Resection of the Mesentery and Intestine.—The triangular portion of mesentery which lies between the proposed points of intestinal resection is cut away, leaving as much blood supply as possible. A cobbler's stitch is a rapid and efficient method of closing the mesentery. After all bleeding points have been ligated, the gangrenous intestine that lies between the two inner clamps is cut away. The margins of each portion of the severed intestine are picked up with fine forceps and held open while the mucosa is thoroughly cleansed with small sponges, moistened with an antiseptic solution. Horsley called attention to the importance of cleansing the mucosa in this manner to lessen the danger of leakage after end-to-end anastomosis.

Emptying the Afferent Loop.—The distended afferent loop of bowel that lies above the constriction should always be emptied. The gas is removed by puncturing the distended intestine with a large hypodermic needle, the contents of the intestine are stripped back, a pursestring suture introduced, and an opening made inside of the suture, just large enough to admit a Paul, Moynihan, or Keith drainage tube, or an ordinary one-half inch (1.25 cm.) glass tube, if nothing else is available. One end of the tube is heated in a flame and the end flared out by inserting a forceps and spreading the blades. In an emer-

gency a piece of stiff rubber tubing can be used. The tube is pushed up into the intestine as far as possible and held in place by tying the pursestring suture. A long rubber hose is attached to the tube, and the intestinal contents allowed to drain while the operation proceeds. (Fig. 11.)

The intestinal contents of strangulated hernia are highly toxic, and if allowed to pass through the intestinal canal they are absorbed, increasing the

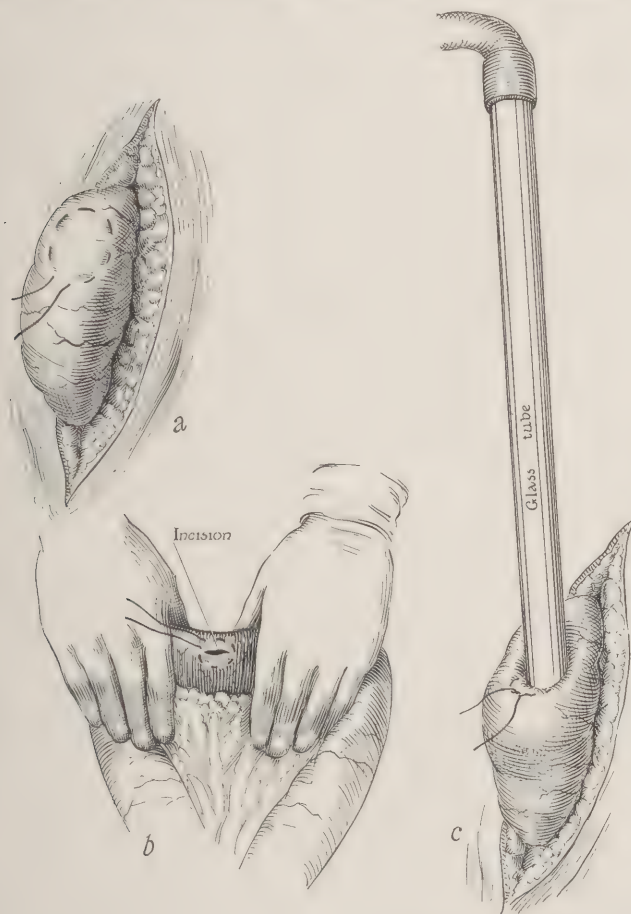


FIG. 11.—Emptying the afferent loop in the treatment of strangulated hernia.

a. A pursestring suture is placed around the site of the incision in the intestine.

b. The intestinal contents are stripped back, and the intestine opened by a short incision within the pursestring suture.

c. The drainage tube is introduced through the opening and the pursestring suture tightened and tied to prevent leakage. The intestinal contents are allowed to drain while the resection is being done. Emptying the afferent loop greatly lowers the mortality in strangulated hernia operations.

toxemia that is already present. This routine emptying of the afferent loop lowers the mortality of strangulated hernia from 25 to 50 per cent.

1. *The Anastomotic Button.*—The anastomotic buttons most generally used are those devised by Murphy and by Jaboulay. Moynihan's absorbable bobbin

is also popular. Intestinal anastomosis with the anastomotic button provides a quick, simple, and fairly safe method of uniting the resected ends of the intestine. It is especially valuable when the operation must be performed rapidly, and when it is impossible to bring the intestine up into the wound. The Murphy and Jaboulay buttons are made in two shapes, oblong and round. The round button is most frequently used for end-to-end anastomosis.

After the clamps are applied and before the gangrenous intestine is cut away, a pursestring suture of the serous and muscular layers is made entirely around the circumference of the intestine at the proposed points of anastomosis. The gangrenous intestine is cut away; one end of the button, lightly held by a mosquito forceps, is passed into the intestine, and the pursestring suture tied. The procedure is repeated at the other end of the resected intestine, and the

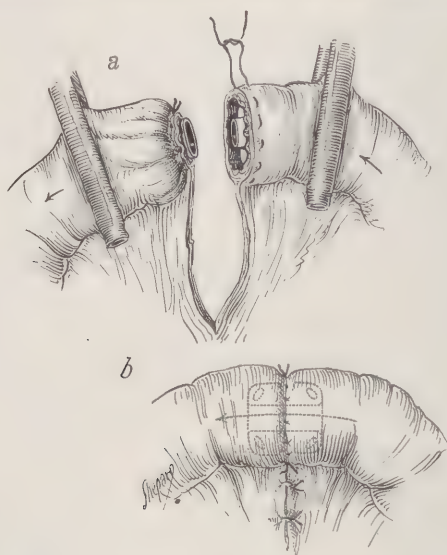


Fig. 12.—Anastomosis with the Murphy button.

a. The half of the button with the smaller stem is placed in the afferent loop, and the half with the larger stem introduced into the efferent loop. The pursestring sutures are being tied.

b. The ends of the button have been forced together, the closure reenforced with a row of interrupted sutures, and the edges of the mesentery stitched together.

two ends forced together. Care must be taken that no mucosa is caught between the two layers of serosa. The opening in the mesentery is closed by interrupted sutures and the anastomosis is reenforced with interrupted sutures of linen or chromic catgut which penetrate only the serous and muscular layers of the intestine. When either end of the anastomotic button fits tightly into the intestinal segment, it should not be used on account of the danger of necrosis and peritonitis, or of obstruction. (Fig. 12.) The button causes a pressure necrosis and becomes free in two to three weeks, when it is passed by rectum. In isolated instances, the button has caused intestinal obstruction. When the large intestine is involved, the oblong button is ordi-

narily used and the anastomosis is made by lateral approximation, the openings in the intestine being made at a point opposite the mesentery.

2. *Lateral Anastomosis*.—When intestinal anastomosis is required and it is necessary to perform the operation rapidly, a lateral or side-to-side anastomosis is quicker and safer than the end-to-end method.

The gangrenous intestine between the double clamps is cut away. The open ends of the intestine are closed in the following manner: For small intestine it is sufficient to clamp the intestine, apply a strong ligature, invert the stump, and apply a pursestring suture to the serosa; for large intestine the ends are closed most securely by first applying a continuous suture of chromic catgut, followed by a serous suture of linen.

With the ends closed, lateral rubber-covered clamps are applied so that a lateral segment of the bowel, three to four inches (7.5 cm. to 10 cm.) long, and half the circumference of the intestine, is caught in the bite of the clamps. The segments are placed side by side with their stumps at opposite ends, so as to interfere as little as possible with the subsequent establishment of peristalsis. The anastomosis is facilitated by the use of a three-bladed clamp, to approximate the lateral segments of the bowel.

Two layers of continuous sutures are inserted in the following manner: The first half of the outer suture is applied parallel to the mesenteric border of the segments and close to it. This stitch is a continuous Lembert, or right angle stitch of chromicized catgut No. 0. (Some surgeons use linen for this suture.) The suture passes through the serous, muscular and submucous coats of the intestine. When the first half of the outer suture is completed, the ends are tied and left long without removing their needles, and are covered with a compress or towel while each segment of intestine is incised longitudinally on its free surface opposite the mesentery. These incisions in the intestine are about one-quarter of an inch (6 mm.) shorter than the first half of the outer suture. The opened intestinal segments are carefully cleansed with moist antiseptic compresses.

The cut edges of intestine are united by the inner suture which is a continuous right angle stitch of chromic catgut No. 0, that passes through all the coats of the bowel from mucosa to serosa, and from serosa to mucosa. This suture is begun in the middle of the wound, uniting the inner edges of the intestine, and is continued half way around the circumference of the wound. With a needle on the other half of the suture, the remaining half of the opening is sutured, and the ends tied together on the mucous side. This stitch must be snug enough to prevent leakage, but not tight enough to produce necrosis.

The intestinal clamps are removed, and the remaining half of the outer stitch completed, and tied in the middle, so as to give a tight closure of the corners. The suture is cut close, and the angle formed at the junction of the mesentery and intestine is closed with a few sutures of No. 0 chromicized gut. (Fig. 13.)

Anastomosis Above the Strangulation.—When the condition of the patient is grave, a lateral anastomosis above the strangulation is sometimes advisable.

If the strangulated loop cannot easily be drawn down into the wound, a low lateral abdominal incision is made, the healthy intestine anastomosed above the strangulation, the necrotic loop cut away or left undisturbed in the sac, and the wound left open. Because the anastomosis is against the peristaltic current, the resultant fistula does not close as quickly as when the anastomosis is with the current. However, there is little danger of leakage in the suture line, and the fistula usually closes spontaneously in a few weeks' time. I have had good results with this method in serious cases. (Fig. 14.)

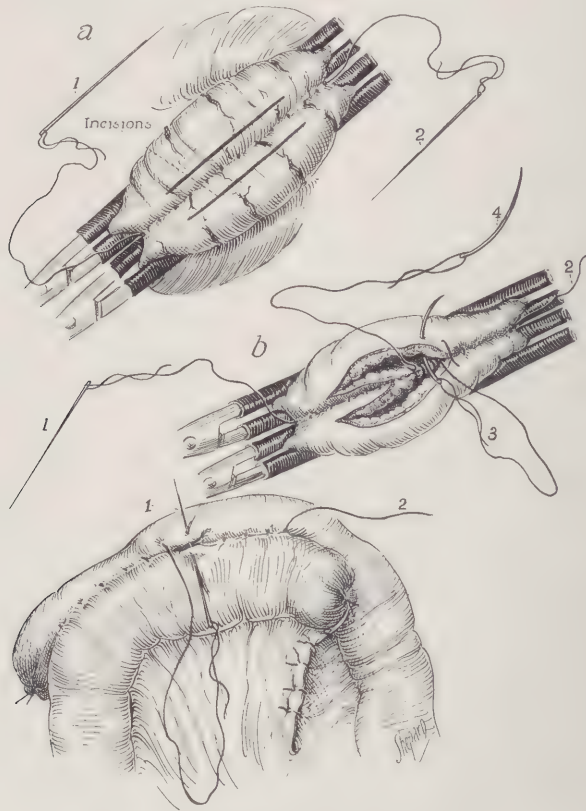


Fig. 13.—Lateral intestinal anastomosis.

a. The ends of the intestine have been closed, the rubber-covered clamps applied, the loops approximated, and the first half of the continuous suture completed (threads 1 and 2). The black lines show the position of the intestinal incisions.

b. The intestinal incisions have been made, and the through-and-through suture is nearly half completed (threads 3 and 4). The loop of the suture is on the inside so as to invert the edges when the stitch is tightened.

c. The through-and-through suture has been completed and the clamps removed. The continuous suture (threads 1 and 2) is completed. The cut edges of the mesentery are stitched to the side of the wall of the mesentery with interrupted sutures.

3. *End-to-End Anastomosis.*—For end-to-end anastomosis the intestinal ends at the proposed point of resection are cut obliquely, usually 30 to 45 degrees less than a right angle. By cutting the intestine obliquely, the mesenteric portion is longer than the part opposite the mesentery. Thus the intes-

tine is assured of a good blood supply, and there is also less danger of post-operative narrowing of the intestinal lumen, than when the intestine is divided at right angles. The cut ends of the intestine are thoroughly cleansed with moist pledgets of gauze.

A long suture 12 to 15 inches (30 to 37.5 cm.) of chromicized catgut No. 0, is threaded on a straight round (a milliner's needle is best) needle, and a mattress mesenteric stitch applied in the following manner: The needle is passed from within outward, about one-eighth of an inch (3 mm.), just to one side of the mesenteric border. It passes through the mucosa into the connective tissue of the mesenteric angle, emerging through the peritoneum at the mesenteric-intestinal junction. From this point the needle passes across to the opposite segment of intestine where it penetrates the peritoneum and mucosa. Here its course is reversed and it returns on the opposite side of the mesentery to the starting point, where the ends are tied and cut. The cut ends of the intestine are folded back with the serous surfaces in contact, so that they look

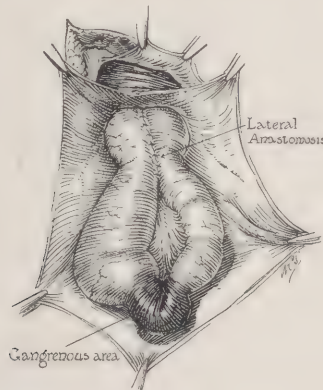


Fig. 14.—Intestinal anastomosis above the strangulation. When the condition of the patient will not permit the ordinary resection, it is sometimes possible to pull healthy intestine down into the sac and do an anastomosis. The necrotic loop can be cut away or allowed to remain in the sac, and the wound left open.

like a double-barreled gun. A No. 0 chromic catgut suture is passed from the serosa to the mucosa of one segment, and returned through the mucosa and serosa of the other segment. The suture is tied and left long to be used as a traction thread. A second suture is passed through all the coats on the opposite side of the mesenteric angle, so that the distance between the two traction threads is about one-third of the circumference of the intestine. While traction on these threads approximates the cut edges, the first thread is used as a continuous suture until it reaches the second thread, when a third traction suture is introduced at a point midway between the first and second ones. The continuous stitch unites the intestinal edges lying between the second and third traction threads.

The second traction thread is now removed, and the last third of the intestinal suturing is completed while the edges of the intestine are approximated by pulling on the first and third traction threads. The last stitch emerges

through the serosa and is tied to the end of the first stitch. Some operators tie this suture on the inside of the intestine in order to provide equal tension while applying the continuous suture.

It is a good plan to take a back stitch every third or fourth stitch to lock the thread and prevent it from slipping. A second row of sutures is applied uniting the serous surfaces of the bowel segments. If time permits, interrupted Lembert sutures should be used for the second tier. When the operation has to be done hurriedly, Cushing's parallel continuous stitch can be employed.

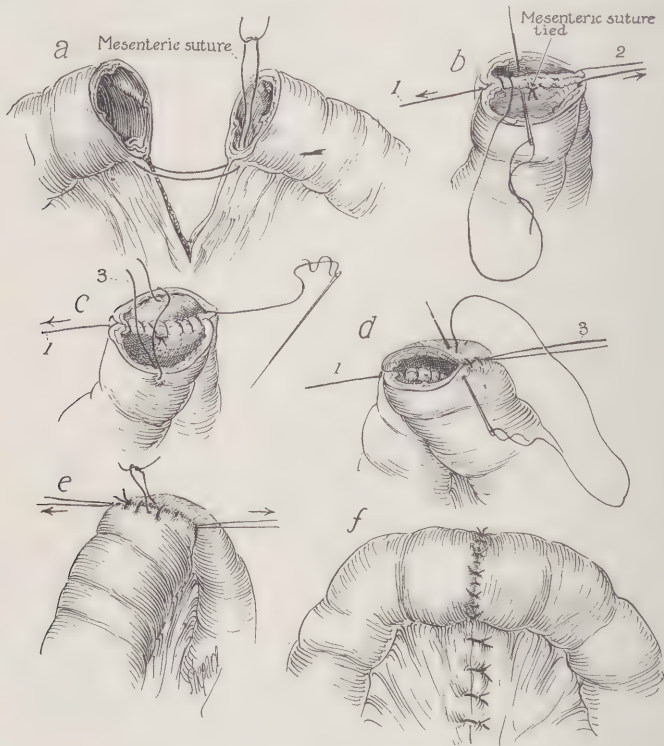


Fig. 15.—End-to-end anastomosis.

a. The intestinal ends are cut obliquely, and the mattress mesenteric stitch has been placed and is ready to be tied.

b. The mattress mesenteric suture has been tied. The first traction thread is passed and tied (thread 1); the second traction thread is also inserted and tied (thread 2); and the intestinal ends are stitched together with a continuous through-and-through suture (thread 1).

c. The third traction thread is inserted (thread 3), and the through-and-through stitching continued (thread 1).

d. The second traction thread has been removed. The last third of the anastomosis is being closed with the through-and-through suture.

e. The first row of suturing is completed. Two traction threads have been inserted, and the reinforcing serosa sutures have been started.

f. The intestinal anastomosis completed and the mesentery closed.

The first stitch of the second row is placed opposite the attachment of the mesentery to the intestine, and left long to act as a traction thread. If interrupted sutures are used, it is a good plan to insert two more traction threads at equidistant points along the circumference of the bowel. (Fig. 15.)

End-to-End Anastomosis with the Basting Stitch.—The basting stitch method of intestinal anastomosis is not to be recommended for routine use. However, it is very simple to execute, and because it is quicker than the method just described, it is suitable in certain cases where the intestinal

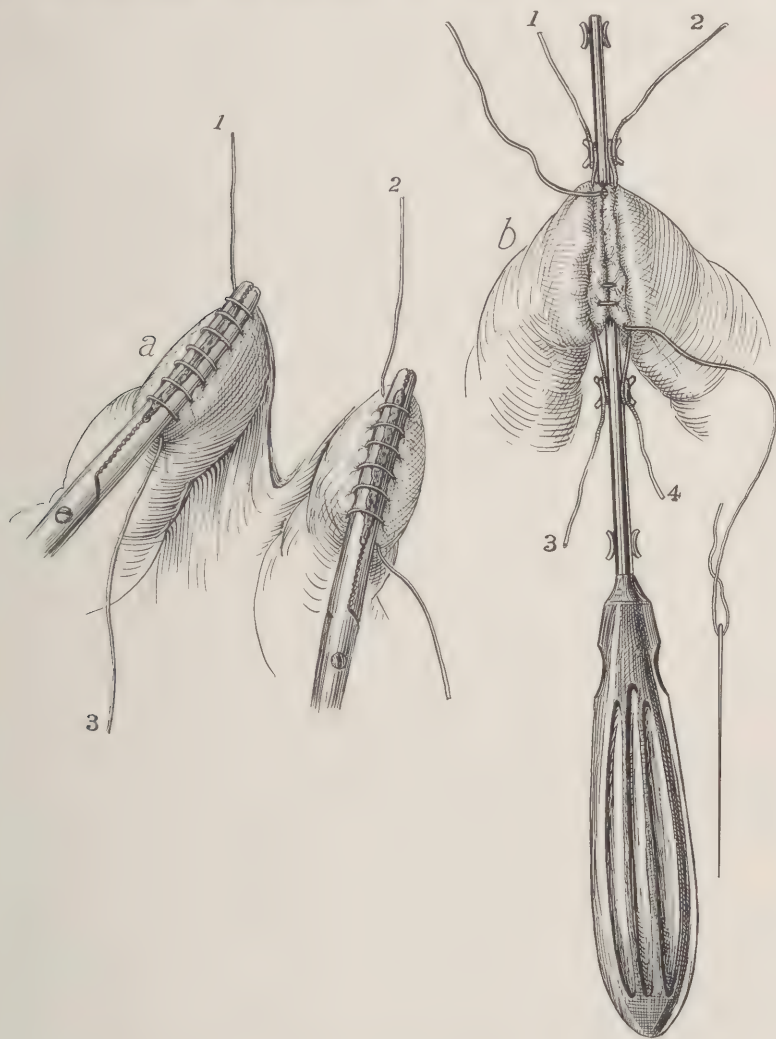


Fig. 16.—End-to-end anastomosis with the basting stitch.

a. Thin narrow-bladed clamps have been applied obliquely to the intestine and the latter divided with a cautery, flush with the side of the clamps. The basting threads have been placed.

b. The clamps have been removed, the basting threads tightened, and the long ends of the threads secured around the buttons of the intestinal suture staff. The first half of a continuous right-angle serosa-muscular suture has been inserted.

lumen is not too small. When an assistant is not available to hold the basting threads, the intestinal suture staff which has been made for me by the Kny-Scheerer Co., is invaluable. This staff has four buttons on each side,

placed at convenient intervals, so it can be used for the stomach, small or large intestine. One or two turns around a button will hold the thread securely.

The basting stitch method is as follows: A thin narrow-bladed clamp is applied obliquely to each segment of intestine which is then divided with a cautery, flush with the clamp. Each end of intestine is temporarily closed with a basting stitch which consists of a continuous right-angled suture without knots, applied very close to the outer side of the forceps blade as shown in the illustration. I use fine linen or silk for this basting thread.

The basting thread is tightened as the clamp is removed, automatically inverting the edges of the intestine along its entire circumference. After both basting threads are tightened, their ends are secured by one or two turns around convenient buttons on the staff. With the intestinal segments side by side a serosa-muscular suture is easily and quickly placed—an interrupted Lembert or a continuous right-angled stitch entirely around the circumference of the intestinal segments. The staff is removed, the mesentery sutured, and the anastomosis reenforced by a second row of sutures or a flap of omentum tacked over the sewn edges. (Fig. 16.)

If the openings in the intestine are unequal, the larger one is gathered or puckered on the basting thread so that it corresponds to the smaller one. I have used the method for gastroenterostomy.

The principal objection to the basting stitch method is that it leaves more tissue in the lumen of the intestine than the ordinary suture method just described, and for this reason there is probably greater danger of post-operative narrowing of the lumen. To lessen the danger of stenosis, the turned-in edge should be as narrow as possible. Valuable papers on this method of anastomosis have been published by Parker and Kerr, and Trueblood.

Combined or Double Operation for Strangulated Hernia.—When gangrenous intestine is found in the hernial sac, and the condition of the patient is good, it is sometimes a good plan to open the abdomen through a lateral rectus incision and anastomose the afferent and efferent loops above the hernial ring, by means of an anastomotie button. The gangrenous bowel is fastened in the wound and when the necrotic area sloughs open it is treated as a fistula. Healing is much quicker than after the ordinary operation for artificial anus. This operation has given a very low mortality in the hands of Estapé. When the condition of the patient does not justify the opening of the abdomen it is often possible to draw the loops down in the wound and do an anastomosis above the gangrenous area, and fasten the intestine, at the site of anastomosis, to the neck of the sac.

Artificial or False Anus.—An artificial anus should be formed when the condition of the patient does not warrant a more extensive operation. This emergency procedure is most suitable for strangulated hernias of the descending colon or sigmoid. The constricting ring is divided and the strangulated loop drawn down until the healthy intestine of both the afferent and effer-

ent loops are in the wound. The healthy serosa of both loops is sutured to the parietal peritoneum, as high as possible above the hernial ring, by means of a continuous Lembert suture of chromic catgut.

The gangrenous portion of the intestine is cut away, and a glass tube or a stiff rubber tube is tied into the distended afferent loop to drain off its septic contents. The resected ends of the intestine are walled off from the peritoneal cavity by gutta percha or rubber dam. Oiled paper can be used in an emergency. A voluminous, fluffed gauze dressing is applied, and changed frequently for the first day or two. The drainage tube can be removed as soon as firm peritoneal adhesions are established, which is in two or three days.

The after-treatment consists of keeping the skin as free from irritation as possible by the application of vaseline or better still, a thick paste of zinc oxid and castor oil. If the patient survives this emergency operation, the intestinal opening gradually decreases in size, terminating in a fecal fistula which sometimes closes spontaneously in a few weeks or months; however, it is usually necessary to close it by a second operation.

Treatment of Fecal Fistula.—A fecal fistula that does not close in a short time becomes a drain on the patient's strength, and for this reason it is often necessary to close the opening by surgical means. Haggard stated that sometimes the fistula will close spontaneously if it is freed by a circular incision from the fascial edges of the opening. Coffey closed the fistula by indirection. After freeing and dissecting out the fistulous tract, the skin margin is cut off, the edges of the fistula are turned in with linen sutures which are knotted on the inside. The wound is closed in layers and a drain placed in each end of it.

Gangrene of the Hernial Coverings.—An unusual case of gangrene of the abdominal wall complicating gangrene of the cecum, ascending and transverse colon, and the splenic flexure of the descending colon in an umbilical hernia, was reported by Buchanan. He excised the gangrenous mass, implanted the ileum into the wall of the sigmoid, and the patient recovered.

Postoperative Treatment of Strangulated Hernia

The after-treatment of strangulated hernia consists in measures to combat shock, collapse, and toxemia. The patient should be kept warm and saline solution or plain water given by rectum, using the drip method, or it can be given by hypodermoclysis. Stimulants, such as strychnin, digitalis, adrenalin, etc., are administered as required. Glucose and alkalies are used to combat acidosis; glucose 2 per cent and sodium bicarbonate 1 per cent are administered by the Murphy drip method or by enema, 4 ounces every two to six hours. Intestinal paresis should be treated with pituitrin hypodermically.

If local anesthesia has been employed the patient can take whatever liquid food he will, immediately after the operation, providing the intestine has not been resected; if he is very feeble, the early resumption of food is sometimes a life-saving factor. A cathartic should not be administered, as a rule, for a few

days after the operation, because the increased peristaltic movements might cause a break in the suture line, possibly resulting in a fatal peritonitis.

When the intestine has been resected, rectal alimentation is used for 4 to 6 days and a liquid diet by mouth until the tenth day, when light diet can be given. The dressings should be changed regularly. Ordinarily a back rest can be used in four to six days after all hernia operations, excepting the umbilical, ventral and large direct inguinal varieties. (For additional details on postoperative treatment, see the chapters on special hernias.)

Strangulated Hernia in the Aged

Strangulated hernia in the aged should be treated by operation under local anesthesia without preceding attempts at taxis.

Elderly patients should be turned in bed often, beginning a few hours after operation. The administration of fluid should be forced and nourishment resumed as soon as possible. Old people do not stand confinement to bed. They should have a back rest on the second or third day after operation, and the following day they should be gotten into a chair. Often these patients die from being kept in bed too long.

THE MORTALITY RATE FOLLOWING OPERATIONS FOR HERNIA

The mortality rate following the operation for hernia is highest in the umbilical variety, lower in the inguinal, and lowest in the femoral variety.

1. **Nonstrangulated Hernia.**—In nonstrangulated hernia the death rate is lowest in children and highest in the aged. The mortality rate for nonstrangulated inguinal hernia in children is probably about one per cent; it varies from .15 to 3 per cent in different clinics. In 2,672 operations in infants and children collected from ten clinics, there were 29 deaths, a mortality rate of 1.08 per cent.

In adults the mortality rate for nonstrangulated inguinal hernia is approximately .5 per cent. It is about 1 per cent in femoral hernia, and probably 3 to 5 per cent in umbilical and ventral hernia in obese or elderly subjects.

In 6,000 operations for nonstrangulated hernia collected from 15 clinics, there were 62 deaths, or 1 per cent.

2. **Strangulated Hernia.**—Simple reduction of the intestine before gangrene develops, has the most favorable prognosis. When there is gangrene, the mortality is lowest when only omentum is involved; higher when resection of small intestine is required, and highest when partial excision of the colon is necessary.

The mortality rate in strangulated inguinal hernia depends largely on the duration of the strangulation before operation, and whether or not the intestine has become gangrenous. When operation is performed in the first 12 hours the mortality rate is about 5 per cent; within 12 to 24 hours, 10 per cent; and within 24 to 48 hours, 25 per cent.

In femoral hernia the mortality rate is somewhat higher, and in the umbilical and ventral varieties it is nearly twice as high as in inguinal hernia.

Duration of Strangulation and Mortality.—The mortality rate of strangulated hernia is in direct proportion to the duration of the strangulation.

DURATION OF STRANGULATION

	LESS THAN 24 HRS.	24-48 HRS.	3-4 DAYS	4-12 DAYS
Ming	4.76	11.8	28.5	75
Henggeler	8.09	22.2	45.5	60
Luke		17.6	40	
Frickhöffer		19.4	45	50
(1822-58)				
Gussew	5	40	41	44
Alexander	1-12 hrs. 5	41	76	
	12-24 hrs. 28			

Strangulated Hernia in Infants.—Ester studied 202 strangulated hernia operations in infants, and found a mortality rate of 32 per cent for the preantiseptic period, and 11.4 per cent for the antiseptic period, which dates from 1885.

Strangulated hernia in preantiseptic days.—In preantiseptic days, when strangulated hernias were operated on only as a last resort, the mortality rate was very high. Textor stated that in a series of 56 kelotomies for strangulated hernia at Würzburg between 1816 and 1842, there were 24 deaths (48 per cent). Husson collected the records of 227 patients who were operated on in the hospitals of Paris between 1861 and 1864, and found a mortality of 74 per cent. Gosselin performed kelotomy without prolonged attempts at taxis with a mortality rate of only 49.9 per cent.

When the intestine is gangrenous and it is necessary to resect it, or to form an artificial anus, the mortality rate is very high:

MORTALITY RATE IN ALL VARIETIES OF HERNIA

Mikulicz	(1891)	64	per cent.
Zeidler	(1892)	62	" "
Butz	(1892)	48	" "
Akerman	(1899)	55	" "
Hofmeister	(1900)	52	" "
Vaughan	(1905)	33.3	" "
Hesse	(1907)	55	" "
Berkofsky	(1911)	32.6	" "
Gussew	(1913)	57	" "
Guillaume	(1921)	29	" "

The mortality rate for strangulated hernia is still much too high. It can be lowered only by early diagnosis, prompt treatment, a more general adoption of the two-stage operation in gangrenous hernia in the seriously ill patient, and the routine use of local anesthesia.

EMBOLISM AND THROMBOSIS

Embolism and thrombosis sometimes complicate hernia operations or ill advised attempts at taxis. They usually occur in middle or advanced life.

1. Pulmonary Thrombosis.—Pulmonary thrombosis seldom occurs before the first week after operation, usually between the 10th and 14th day. The mortality rate is high. Mauelaire collected from the literature, 50 cases of pulmonary thrombosis following inguinal hernia operation; 12 (24 per cent) of these were fatal. Lenormant collected 233 cases from the literature, and of these 106 (45.5 per cent) were fatal. (For additional information on this subject see Welch's monograph on thrombosis and embolism, and the articles of Ross, and Ochsner and Schneider.)

Symptoms.—The symptoms of pulmonary thrombosis come on without warning, and death may be almost instantaneous. However, the patient usually lives a few minutes; he cries out complaining of suffocation and severe pain over the heart. If obstruction to the blood is not complete, he may live several hours with rapid breathing and marked dyspnea and cyanosis.

Several years ago I operated on a man, 50 years of age, for right inguinal hernia. There were extensive omental adhesions in the sac, but no omentum was excised. Recovery was uneventful until the sixth day, when he suddenly developed symptoms of pulmonary thrombosis and died within five minutes.

Treatment.—*Preventive Measures.*—The principal preventive measures for pulmonary thrombosis may be summed up as follows: The tissues should be handled very gently during the operation; rough retraction should always be avoided; the veins in the field of operation should be ligated carefully and injury to their intima painstakingly avoided; hemostasis should be complete before the wound is closed; the patient's knees should not be bent while on the operating table, because the slowing of the blood stream is an important etiologic factor, and for this same reason, patients with severe anemia should receive a blood transfusion before operation; local infection is unquestionably an important cause, hence absorption areas should not be opened up any more than is necessary during the operation.

Meyer advocated active exercise for hernia patients, to be carried out while they were still in bed to speed up the circulation.

Operative Treatment.—Only a few instances are recorded in the literature in which an attempt has been made to remove a pulmonary embolus by operation. Capelle reported 2 cases in which the operation was unsuccessful, and described the technic in detail.

The removal of an embolus from other arteries has been more favorable. Sundberg collected in the literature 6 cases in which this had been successfully accomplished. He added a case of his own in which the embolus was removed from the femoral artery. The patient survived.

2. Mesenteric Thrombosis.—Mesenteric thrombosis is often associated with arteriosclerosis, and the most important causative factors are probably disturbances in the blood supply, trauma and local infection. Mesenteric throm-

bosis may be venous or arterial. Venous thrombosis gives more indefinite symptoms, and its progress is slower than arterial thrombosis in which the symptoms often resemble those of acute intestinal obstruction. Venous thrombosis has a greater tendency to spontaneous cure than arterial thrombosis.

Treatment.—Immediate operation is indicated when mesenteric thrombosis is suspected. If the mesentery is gangrenous, resection of the intestine is necessary. If the patient's condition is critical, the intestine can be left in the wound, a glass drainage tube inserted, and the intestinal contents allowed to drain.

THE PREVENTION OF ABDOMINAL ADHESIONS

A number of methods have been devised to prevent abdominal adhesions. As the formation of adhesions is a part of the normal process of healing, substances to prevent their development should never be used as a routine. When it is necessary to use something to lessen the formation of adhesions the best substance is a mixture of gelatine 25 per cent, gum acacia 25 per cent and water 50 per cent. As pointed out by Williamson and Mann this mixture when used in the peritoneal cavity, sticks to the site of application, causes no reaction, dissolves in 4 to 8 hours, and is absorbed from the general body cavity. To secure the best results the mixture must be carefully prepared according to the instructions formulated by Williamson and Mann.

Sodium citrate 2 per cent solution has been quite generally recommended for the prevention of adhesions. I have usually found it ineffective and besides there is more than the usual amount of bleeding from raw surfaces because the sodium citrate delays the clotting of the blood.

Other helpful measures are gentle handling of the viscera; protection against drying of the serosa from exposure to the air by keeping all exposed viscera covered with gauze saturated with warm, moist, normal saline solution; and the avoidance of all sponging of intestine, mesentery or omentum with dry gauze.

Corbett says that the principal causes of adhesions are infection, trauma, and hematomata. Omental grafts are valuable for covering raw surfaces when the wound is sterile, but must never be used if there is infection. The section of nerves, when the lateral rectus or other muscle-cutting incision is used, may favor the formation of adhesions.

SHOCK

All patients with strangulated hernia suffer more or less from shock. Consequently, preoperative as well as postoperative treatment is of the utmost importance. The chief factors in combating it are as follows: Rest in bed with the foot of the bed elevated, and an abundance of fluids, such as a solution of 1 per cent sodium bicarbonate and 2 per cent glucose solution per rectum by the drip method, or 2,000 to 3,000 c.c. (mils) of normal saline solu-

tion every twenty-four hours by hypodermoclysis or by intravenous infusion; if intravenous infusion is employed it is sometimes a good plan to add 5 grams of gelatine and 2 grams of acacia to each 1,000 c.c. (mils) of the solution. In certain cases a blood transfusion both before and after operation is advisable. The conservation of body heat is important, and is secured by wrapping the patient in hot blankets and placing hot water bottles or bricks around him. To prevent the spread of peritonitis, he should be placed in the Fowler position, and if there is no contraindication to morphin, small doses are valuable. Sequestration anemia is very useful and it is induced by bandaging the lower extremities, and in severe cases the upper extremities also—this procedure raises the blood pressure and provides more blood for the brain, thoracic and abdominal cavities.

The choice of anesthetic is of paramount importance. Local anesthesia should be used whenever possible. Nitrous oxid is the second choice. If general anesthesia is employed, the entire line of incision should be blocked by local anesthesia, to minimize the shock, and the operation completed as quickly as possible. Loss of blood and body heat must be prevented; the dissection should be as gentle as possible, and the simplest and quickest operation must be used.

Wilson called attention to the value of performing emergency operations in a warm room, and keeping the patient warm for several hours afterwards. He remarked that in Korea the basement floor of the houses is heated by the smoke of the fire used for cooking, which is done under the floor. The floor retains the heat for about twelve hours. Patients are usually operated on in this room and kept there afterward, with the result that postoperative shock is greatly reduced. Patients living in the tropics have less resistance to intraabdominal manipulation than those in the temperate zones. (For additional information see treatment of inguinal hernia.)

METEORISM OR GAS PAINS

Gas pains are minimized by the use of alkalies, such as sodium bicarbonate, before and after operation. Schwartz believed that one of the most effective measures for preventing gas pains is a large ice bag placed on the abdomen and allowed to remain until the gas is passed, which is generally twenty-four hours. Shier stated that the administration of digitalis is valuable in preventing abdominal tympanites or meteorism.

The sipping of very hot water is useful, and elevating the upper part of the body so that the patient is in a semi-sitting posture is also beneficial. The application of pressure to the abdomen is sometimes helpful. Heat applied to the abdomen will aid peristalsis: dry heat, such as electric pads, hot water bottles, bricks, irons, hot air box and electric bulbs may be used, or moist heat, such as hot stupes or packs.

Various sorts of enemas have been recommended, the most popular ones being soap and water, turpentine ($1\frac{1}{2}$ to 1 per cent solution), alum in the same

strength and magnesium sulphate (5 per cent solution). A rectal tube should be passed occasionally or left in position for several hours at a time. In nonstrangulated simple hernia I usually give pituitrin 5 to 15 m. (.33 to 1 c.c. or mil.) every 3 to 4 hours until the bowels move.

Other drugs that have been used are, eserin salicylate, $\frac{1}{60}$ to $\frac{1}{40}$ grain (0.001 to 0.0015 gm.); hormonal, 4 to 5 drams (16 to 20 c.c. or mils). These drugs must not be used in the presence of peritonitis or obstruction.

Gastric lavage with sodium bicarbonate solution should be used early and often. Personally, I have found that meteorism developing after operation for simple hernia is most effectively treated by changing the patient's position frequently, keeping the abdomen warm, and lightly massaging the upper abdomen for fifteen minutes every hour for the first day or two. Meteorism is more marked following the manipulation of small intestine than of large intestine, and more pronounced when the hernial sac is excised than when it is inverted without being opened.

ACUTE DILATATION OF THE STOMACH

Acute dilatation of the stomach sometimes complicates the operation for strangulated and nonstrangulated hernia. Nausea may be the first symptom complained of. As dilatation increases there may be some vomiting, but not enough to relieve the condition. Belching may aid temporarily but is usually of no benefit, as the patient swallows more air than he belches. There is abdominal pain; the stomach is greatly dilated, perhaps extending below the umbilicus and is tense and tympanitic.

Treatment consists of gastric lavage, with warm water or 5 per cent sodium bicarbonate solution, repeated every two to four hours or as needed. An abdominal binder should be applied and the patient turned often from side to side and on his abdomen. The knee-chest or prone position with elevation of the pelvis is most valuable in emergency cases, as it removes the occlusion of the duodenum when it is due to the traction of the mesentery and the weight of the stomach and contents. When the condition tends to recur, the patient should be kept lying on his right side. Dilatation is most liable to occur following the resection of intestine or omentum. After an extensive experimental study, Dragstedt and Dragstedt advocated the frequent administration of large amounts of Ringer's solution to overcome the toxemia. The solution can be given intravenously or by hypodermoclysis. In seriously ill patients Odén advised passing a duodenal tube before operation and leaving it in for 3 to 5 days after operation to relieve nausea, vomiting and distention and to drain off toxic material from the upper intestinal tract.

Acute dilatation of the stomach must not be mistaken for shock, ileus, or intestinal obstruction. Pietri reported the case of a man, aged 30, who after an operation for appendicitis, suddenly developed cyanosis, rapid pulse, dyspnea and nausea, but he could not vomit. Death soon followed, and it was thought that he died from an acute dilatation of the stomach. At autopsy a

strangulated diaphragmatic hernia of the stomach was found. There had been no previous symptoms of this condition.

DIABETES MELLITUS

Diabetics are poor surgical risks and should never be operated on for nonstrangulated hernia without a prolonged course of preoperative treatment to minimize the dangers to which they are prone. In the emergency of strangulation, the anesthetic is the most important factor affecting the mortality. Fitz says that all emergency operations on diabetics should be performed under local or gas-oxygen anesthesia, instead of with spinal or ether anesthesia which give a specially high mortality in these patients.

The preoperative treatment of hernia patients with diabetes mellitus may be briefly summarized as follows: The bowels should be kept open, preferably by enemata, to prevent diarrhea and its resultant drainage from the body of alkaline salts; acid-forming food should be avoided, especially fats and certain proteins; carbohydrate tolerance should be increased and plenty of fluid should be given (4 to 8 ounces, 120 to 240 c.c.) every hour or two. Alkalies must not be administered, as Joslin pointed out they often produce nausea and vomiting, and the elimination of so much acid may overwhelm the kidneys, and produce anuria. Kahn advised the use of foods which favor combustion of ketones, such as oatmeal, levulose, alcohol, etc.

Bibliography

GENERAL OBSERVATIONS

- AKERMAN: See Hesse, E.: p. 179.
 ALBERT, E.: Die herniologie der alten. *Beit. z. Geschichte der Chirurgie*, Wien, 1878, ii, 1-193.
 ALBUCASIS: See Paulus Ægineta: p. 375-376.
 ALEXANDER, E. G.: Report of 105 cases of strangulated hernia. *Ann. Surg.*, Phila., 1913, lviii, 639-646.
 ALLEN, D. S.: A thread-retaining needle. *Surg. Gynec. & Obst.*, Chi., 1921, xxxii, 558-559.
 ARETÆUS: Aretæi Cappadocis. De causis et signis acutorum et diuturnorum morborum, libri quatuor. Oxoniae, Clarendoniano, 1723, p. 23-26.
 ARNAUD, G.: *Traité des hernies ou descentes*. Paris, Le Mercier, 1749, ii, 50-56; 90-96; 131-135.
 ASSEN, J. VAN: Erfahrungen an eingeklemmten Bruchen. *Beitr. z. klin. Chir.*, Tübing., 1909, lxxv, 404-445.
 AVICENNA: *Avicennæ arabum medicorum principis. Canon medicinæ. Ex Girardi Cremonensis. Venetiis, Iuntas, 1594*, p. 963-964.
 BAILLEUL, L. C.: Balle d'obus enrobée par le grand épiploon et mobile dans un sac herniaire. *Progrès méd.*, Par., 1916, p. 228-230.
 BÁRON, A., AND BÁRSONY, T.: Ueber die Röntgenuntersuchung der Hernien. *Beit. z. klin. Chir.*, Tübing., 1913, lxxxiv, 265-272.
 BENELLI, E.: Ossifikation von Laparotomienarben. *Beitr. z. klin. Chir.*, Tübing., 1911, lxxv, 549-564.
 BERGER, P.: Sur le mécanisme de l'étranglement herniaire. *Arch. gén. de méd.*, Par., 1876, xxviii, 204-219; 452-483.
 BERGER, P.: Résultats de l'examen de dix mille observations de hernies recueillies à la consultation des bandages au bureau central du 4 février 1881 au 14 août 1884. *Cong. franç. de chir. Proc. verb. [etc.]*, Par., 1885, ix, 264-452.
 BERGER, P.: *Hernies. In: Traité de chirurgie*, Duplay, S. et Reclus, P., Paris, Masson, 1892, vi, 543-846.

- BERKOWSKY, K.: Erfahrungen bei der operativen Behandlung des abgeklemmten brandigen Darmes. *Deutsche Ztschr. f. Chir.*, Leipz., 1911, cix, 133-159.
- BLAKEWAY, H.: Hernia of urinary bladder. *Lancet*, Lond., 1918, ii, 799-800.
- BOLOGNESI, G.: Sur le mécanisme pathogénique de l'étranglement herniaire. *Arch. de méd. expér. et d'anat. path.*, Par., 1919, xxviii, 403-433.
- BOOKMAN, M. R.: Occult strangulated inguinal hernia; spontaneous reduction "en masse." *Ann. Surg.*, Phila., 1915, lxi, 730-734.
- BRAMWELL, W.: A minute peritoneal hernia through a cleft in the xiphoid cartilage. *Lancet*, Lond., 1902, i, 1177.
- BRIN, O.: Zur Behandlung eingeklemmter Brüche. *Deutsche med. Wchnschr.* Leipz., 1905, xxxi, 1075-1076.
- BROCA, P. P.: De l'étranglement dans les hernies abdominales et des affections qui peuvent les simuler. Thèse de concours, Paris, 1853.
- BUCHANAN, J. J.: Case of strangulated umbilical hernia with unusual features. *Med. Rec.* N. Y., 1904, lxvi, 576-578.
- BUSCH, W.: Beitrag zur Lehre von Mechanismus der Brucheinklemmung. *Centralbl. f. Chir.*, Leipz., 1874, i, 529-531.
- BUSCH, W.: Ueber den Mechanismus der Brucheinklemmung. *Arch. f. klin. Chir.*, Berl., 1875-1876, xix, 59-87.
- BUTZ, R. V.: See Hesse, E.: p. 179.
- CAPELLE, W.: Einiges zur Frage der postoperativen Thromboembolie. *Beitr. z. klin. Chir.*, Tübing., 1920, cxix, 485-517.
- CELSUS, A. C.: De arte medica, editi G. P. Tiliatani. Basileæ, per Ioannem Oporinum, 1552, 519-421.
- COFFEY, R. C.: Closure of fecal fistulæ by indirection. *Journal-Lancet*, Minneapolis, 1919, xxxix, 633-638.
- COLEY, W. B.: Hernia. In: *Keen's Surgery*. Phila. and Lond., W. B. Saunders Co., 1908, iv, 17-109.
- CONNOR, E. P.: Notes on eighty-five consecutive cases of strangulated hernia. *Indian M. Gaz.*, Calcutta, 1910, xlv, 447-452.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme Brown & Green 1827.
- CORBETT, J. F.: Peritoneal adhesions. *Surg. Gynec. & Obst.*, Chi., 1917, xxv, 166-174.
- CORNER, E. M., AND HOWITT, A. B.: The reduction en masse of strangulated and non-strangulated herniæ. *Ann. Surg.*, Phila., 1908, xlvii, 573-587.
- CORNER, E. M.: The treatment of gangrene in strangulated herniæ at St. Thomas' Hosp., 1901-5., *Lancet*, Lond., 1908, i, 1692.
- COVILLARD, J.: Le chirurgien opérateur. 2 ed. Lyon, P. Ravaut, 1640, p. 114.
- DE GARMO, W. B.: Abdominal hernia. Phila. and Lond., Lippincott, 1907.
- DEVÉ, M. P.: Echinoecose herniaire. *Presse méd.*, Par., 1917, xxv, 643.
- DIONIS, P.: Traité complet des opérations de chirurgie. La Vauguion. Paris, B. Girin, 1698, p. 68-89.
- DOYEN, E.: Surgical therapeutics and operative technique. English transl. by H. Spencer-Browne, New York, W. Wood & Co., 1920, iii, 29-80.
- DRAGSTEDT, L. R., AND DRAGSTEDT, C. A.: Acute dilatation of the stomach. *J. Am. Med. Assn.*, Chi., 1922, lxxix, 612-615.
- ECCLES, W. M.: Hernia. 3rd ed., New York, W. Wood & Co., 1908.
- ELIASON, E. L.: Hernia reduced "en bloc." *J. Am. Med. Assn.*, Chi., 1921, lxxvii, 2049-2050.
- ESTAPÉ, G.: Un procedimiento para la cura de las hernias estranguladas, con gangrena, de la región inguinal y crural. *Rev. españ. de med. y cirug.*, Barcelona, 1919, ii, 595-598.
- ESTON, E.: La hernie étranglée chez le nourrisson (depuis sa naissance jusqu'à l'âge de deux ans). *Rev. de chir.*, Par., 1902, xxv, 249-293; 436-454; 721-745.
- FIOLE, J.: Les lésions graves du mésentère dans la hernie étranglée. *Bull. et mém. Soc. de chir. de Par.*, 1919, xlv, 812-815.
- FITZ, R.: Surgical anesthetics in diabetes mellitus. *Med. Clin. N. A.*, Phila., 1920, iii, 1107-1125.
- FRANCO, PIERRE: Petit traité, contenant une des parties principales de chirurgie. Lyon, A. Vincent, 1556, p. 11-46.
- FRICKHÖFFER: Die im Herzogthum Nassau in den Jahren 1818 bis 1858 vorgekommenen Bruchoperationen und Kothfisteln. Wiesbaden, L. Schellenberg, 1860.
- GALLO, A.: Desinserción mesentérica en las hernias estranguladas. *Semana méd.*, Buenos Aires, 1918, xxv, 553-554.
- DE GARENGEOT, R. J. C.: Traité des opérations de chirurgie. Paris, Huart, 1731, i, 261-269.

GATINARI, M.: See Albert, E.: p. 177.

GIL Y ORTEGA: El citrato de cafeína en la hernia estrangulada. Siglo méd., Madrid, 1917, lxiv, 41-43.

GOSSELIN, L.: Leçons sur les hernies abdominales. Paris, A. Delahaye, 1865.

GOURSAUD: Sur la différence des causes de l'étranglement dans les hernies. Mém. Acad. roy. de chir., Par., 1768, iv, 243-280.

GRASER, E.: Hernia. In: A system of practical surgery. Bergmann-Brunns-Mikulicz. English transl. ed. by W. T. Bull. New York and Phila., Lea Bros., 1904, iv, 483-629.

GROS-DEVAUD, L.: De la carcinose herniaire, Thèse, Paris, 1903.

GUILLAUME, A. C.: Le pronostic dans l'occlusion intestinale aiguë. Presse méd., Par., 1921, xxix, 822-825.

GUSSEW, V.: Beitrag zur Therapie der eingeklemmten Brüche auf Grund von 420 Fällen. Deutsche Ztschr. f. Chir., Leipz., 1913, cxxiv, 155-192.

HAGEN: Theorie und Praxis der Behandlung eingeklemmter Brüche durch Atropin. Deutsches Arch. f. klin. med., Leipz., 1903, lxxviii, 482-520.

HAGGARD, W. D.: Fecal fistula following strangulated hernia, with report of five cases operated upon. Ann. Surg., Phila., 1918, lxviii, 272-274.

HARRISON, G. A.: Strangulation following reduction en masse (left inguinal hernia); laparotomy; recovery. Brit. M. J., Lond., 1917, i, 763-764.

HENGGELE, O.: Statistische Ergebnisse von 276 incarcerierten Hernien. Beitr. klin. Chir., Tübing., 1895-1896, xv, 1-98.

HESSE, E.: Die Behandlung der gangränösen Hernien. Beitr. f. klin. Chir., Tübing., 1907, liv, 172-203.

HEWITT, H. W.: The preparation of the skin for operation, with special reference to the use of picric acid. Am. J. Obst., St. Louis, 1921, i, 672-676.

HINDSE-NIELSEN, S.: Om Tarmruptur efter Kontusion af Hernier. Ugesk. f. Læger, Kjøbenh., 1919, lxxxii, 713-723.

HIPPOCRATES: See Aretæus: p. 23-26.

HIPPOCRATES: See Sabatier: p. 55.

HOFMEISTER: Ueber die Behandlung brandiger Brüche mit primärer Darmresektion. Beitr. z. klin. Chir., Tübing., 1900, xxviii, 671-705.

HORSLEY, J. S.: Operative surgery. St. Louis, C. V. Mosby Co., 1921, p. 69-91; 603-622.

HUGUIER: See Jaboulay, M. et Patel, M.: p. 84.

HUSON: See Jaboulay, M., et Patel, M.: p. 95.

IMBERT, L.: Rapport sur deux observations de résection intestinale pour cancer. Rap. par Quénu. Bull. et mém. Soc. de chir. de Par., 1901, xxvii, 357-364.

JABOULAY, M., AND PATEL, M.: Hernies. xxv Nouveau traité de chirurgie. Le Dentu, A. et Delbet, P. Paris, Baillière, 1908.

JOSLIN, E. P.: Treatment of diabetes mellitus. Phila., Lea & Febiger, 1917, p. 394.

JACKSON, J. A.: Hernia in the chronic insane. New York, M. J., 1915, cii, 245-247.

KAHN, M.: Pre-operative preparation of diabetic patients and their subsequent treatment. Surg. Gynec. & Obst., Chi., 1920, xxxi, 363-365.

KERR, H. H.: The development of intestinal surgery, J. Am. Med. Assn., 1923, lxxxii, 641-646.

KOCHEK, T.: Zur Lehre von der Brücheinklemmung. Centralbl. f. Chir., Leipz., 1875, ii, 1-5.

KOCHEK, T.: Die Lehre von der Brücheinklemmung. Deutsche Ztschr. f. Chir., Leipz., 1877, viii, 331-450.

LANE, J. W.: A report of an unusual case of umbilical hernia. Boston M. & S. J., 1917, clxxvi, 64-65.

LAROYENNE: Hernies compliquées d'étranglement retrograde de l'intestin. Lyon chirurg., 1910, iii, 698-705.

LAVATER, J. H.: De testinorum compressione. Basileæ, 1672. In: Haller. Disputationes chirurgicæ selectæ. Lausanne, Bousquet, 1755, iii, 37-62.

LECÈNE, P.: Volumineuse hernie inguinale irréductible avec sténose de l'intestin grêle et kyste du mésentère. Presse méd., Par., 1913, xxi, 942-943.

LECÈNE, P.: Hernie inguinale congénitale étranglée avec désinsertion mésentérique spontanée. Bull. et mém. Soc. de chir. de Par., 1919, xlv, 828-829.

LE DRAN, H. F.: Observations de chirurgie. Paris, C. Osmont, 1731, ii, 1-58.

LENORMANT, C.: Les embolies pulmonaires post-opératoires. Arch. gén. de chir., Par., 1909, iv, 221-239.

LEJARS, F.: Néoplasmes herniaires et péri-herniaires. Gaz. d. hôp., Par., 1889, lxii, 801-811.

LEQUIN, N.: Le chirurgien herniaire. Paris, L. d'Houry, 1697.

LISTER, J.: On the antiseptic principle in practice. Brit. M. J., Lond., 1867, ii, 246-248.

LOSSEN, H.: Die elastische und die Koth-Einklemmung. Arch. f. klin. Chir., Berl., 1875-1876; xix, 88-102.

LOUIS, A.: Sur la cure des hernies intestinales avec gangrène. Mém. Acad. roy. de chir., Par., 1781, viii, 27-119.

- LOUIS, A.: Sur l'opération de la hernie. *Mém. Acad. roy. de chir., Par.*, 1784, xi, 442-507.
- LUKE, T. D.: See Macready, J. F. C. H.: p. 365.
- MCDONALD, E.: Disinfection of the hands and abdominal skin before operation. *Surg. Gynec. & Obst., Chi.*, 1915, xxi, 82-86.
- MACFARLAN, D.: Notes in the study of potassium mercuric-iodide. *J. Am. Med. Assn., Chi.*, 1914, lxii, 17-19.
- McKENNA, W. F., AND FISHER, H. A.: The use of potassium-mercuric iodide for skin disinfection. *Surg. Gynec. & Obst., Chi.*, 1920, xxx, 370-373.
- MACLENNAN, A.: On the presence of adrenal rests in the walls of hernial sacs. *Surg. Gynec. & Obst., Chi.*, 1919, xxix, 387-388.
- MACREADY, J. F. C. H.: A treatise on ruptures, London, Griffin & Co., 1893.
- MALGAIGNE, J. F.: Leçons cliniques sur les hernies, Paris, Germer-Baillière, 1841.
- MALGAIGNE, J. F.: Mémoire sur les étranglements herniaires; des pseudo-étranglements, ou de l'inflammation simple dans les hernies. *Arch. gén. de méd., Par.*, 1841, 3s, xii, 195-227; 289-313.
- MALGAIGNE, J. F.: Leçons cliniques sur les hernies. Paris, Germer-Baillière, 1841.
- MARCHETTI, G.: Sopra un caso di ernia ischiatica contenente un ampio biverlicolo sigmoideo formatasi da causa mai ancora notata. *Policlin., Roma*, 1919, xxvii, sez. chir., 214-248.
- MARCY, H. O.: A new use of carbolized catgut ligatures. *Boston M. & S. J.*, 1871, n. s. viii, 315-316.
- MAUCHART, B. D.: De hernia incarceration. Tübing., 1722. In: Haller. *Disputationes chirurgicæ selectæ. Lausannæ, Bousquet*, 1755, iii, 75-96.
- MAUCLAIRE, P.: Embolies pulmonaires après la cure radicale des hernies inguinales. *Arch. gén. de chir., Par.*, 1908, ii, 573-587.
- MAYDL, C.: Ueber retrograde Incarceration der Tuba und des Processus vermiformis in Leisten- und Schenkelhernien. *Wien. klin. Rundschau*, 1895, ix, 17-18; 33-35.
- MÉRY, J.: See Jaboulay, M. et Patel, M.: p. 84.
- MEYER, G.: See Emmert, C.: Der Mechanismus der Brucheinklemmung. *Centralbl. f. Chir., Leipz.*, 1887, xiv, 393-396.
- MEYER, W.: The importance of posture in postoperative treatment. *Surg. Clin. N. A., Phila.*, 1921, i, 283-305.
- MIKULICZ: See Hesse, E.: p. 179.
- MING, A.: Die Schenkelhernien. [Basle], I. D., Sarnen, 1910.
- MOCK, H. E.: Industrial medicine and surgery. *Phila. & Lond., W. B. Saunders Co.*, 1919, p. 690-706.
- MORAND: See Heister, D. L.: *Institutiones Chirurgicæ. Amstelodami, J. Wacsbergios*, 1797, ii, 747.
- MULLER, M.: Des hernies étranglées crurales et inguinales à signes locaux frustes. *Lyon chirurg.*, 1911, vi, 502-522.
- MURRAY, R. W.: Hernia. 2nd ed. *Phila., Blakiston*, 1910.
- MURRAY, R. W.: A case of irreducible hernia and perforation of the duodenum. *Lancet, Lond.*, 1911, i, 1349-1350.
- O'BEHNE, J.: On the primary causes of strangulation, and an improved mode of performing the taxis, in cases of intestinal herniæ. *Dublin M. J. Sc.*, 1838-1839, xiv, 88-130.
- OCHSNER, A. J., AND SCHNEIDER, C. C.: Fatal postoperative pulmonary thrombosis. *Ann. Surg., Phila.*, 1920, lxxii, 91-108.
- ODÉN, C. L. A.: The treatment of postoperative nausea, vomiting, and distention in certain abdominal sections by the use of a modified duodenal tube. *Surg., Gynec., & Obst., Chi.*, 1923, xxxvi, 572-573.
- OGLIVIE, W. H.: Two unusual cases of small intestine obstruction. *Lancet, Lond.*, 1921, i, 120-121.
- PARÉ, A.: Les oeuvres. Paris, G. Buon, 1579, p. 297-306.
- PARKER, E. M., AND KERR, H. H.: Intestinal anastomosis without open incisions by means of basting stitches. *Johns Hopkins Hosp. Bull., Balto.*, 1908, xix, 132-137.
- PASSOT, R.: Procédés modernes et nouveaux de suture esthétique. *Presse méd., Par.*, 1920, xxviii, 693-695.
- PAULUS ÆGINETA: Seven books of, transl. by F. Adams. *Lond., The Sydenham Society*, 1846, p. 372-379.
- PERASSI, A.: Le gradazioni dell'ernia crurale. *Gior. di med. mil., Roma*, 1911, lix, 41-43.
- PETIT, J. L.: Oeuvres complètes. Limoges, F. Chapouland, 1837, p. 608-689.
- DE LA PEYRONIE: Observations avec des réflexions sur la cure des hernies avec gangrène, *Mém. Acad. roy. de chir., Par.*, 1743, i, 337-346.
- PFISTER, C.: A lecture on strangulated hernia. *Phila. M. J.*, 1901, viii, 559-563.
- PIETRI, G. A.: Una causa rara di morte post-operatoria. *Policlin., Roma*, 1920, xxvii, sez. chir., 56-60.
- PIGRAY, M. P.: Epitome des preceptes de médecine et chirurgie. *Lyon, A. Beaujollin*, 1682, p. 222-229.

- PILCHER: Sarcomatous degeneration of hernial sac. Year Book, Pilcher Hosp., Brooklyn, 1913, iii, 23.
- PIRIE, G. A.: The diagnosis of the contents of a hernial sac by X-ray examination. Edinb. M. J., 1912, n.s. viii, 137-138.
- PRAXAGORAS OF COS: See Albert, E.: p. 123.
- PRINTY, E. A.: An improved needle forceps. Surg. Gynec. & Obst., Chi., 1922, xxxiv, 679.
- RABÈRE, J., AND CHARBONNET, M.: Désinsertion du mésentère au niveau de l'intestin dans la hernie étranglée. Rev. de chir., Par., 1910, xlii, 876-888.
- REICHEL, P.: De Lehre von der Brucheinklemmung. Stuttgart, F. Enke, 1886.
- REICHEL, P.: Entgegnung auf Roser's Vertheidigung der Lehre von den Brucheinklemmungsklappen. Centralbl. f. Chir., Leipz., 1886, xiii, 857-858.
- RHAZES: Opera parva Albubetri. Lugduni, 1510.
- RICHTER, A. G.: Abhandlung von den Bruchen. Göttingen, J. C. Dieterich, 1785.
- RIOLAN, J. (fils): Encheiridium anatomicum et pathologicum. Parisiis, C. Meturas, 1658, p. 105; 166-167; 397-398.
- RITTER, C.: Experimentelle Untersuchungen über Einklemmung von Bruchen. Arch. f. klin. Chir., Berl., 1908, lxxxvii, 691-708.
- ROSER, W.: Zur Lehre von den Brucheinklemmungsklappen. Centralbl. f. Chir., Leipz., 1874, i, 561-562.
- ROSS, G. G.: Mesenteric thrombosis. Ann. Surg., Phila., 1920, lxxii, 121-128.
- RUSSELL, R. H.: The etiology and treatment of inguinal hernia in the young. Lancet, Lond., 1899, ii, 1353-1358.
- SABATIER, C.: Sur les anus contre-nature. Mém. Acad. roy. de chir., Par., 1774, xv, 1-56.
- SAINT, C. F. M.: Inguinal hernia in a child, with a suprarenal rest in the spermatic cord. Brit. M. J., Lond., 1912, ii, 1139.
- SALA, J. D.: See Lavater, J. H.: p. 50.
- DE SALICET, W.: See Albert, E.: p. 153.
- SANGER, F.: Die Taxisrupturen des eingeklemmten Bruchdarmes. Beitr. z. klin. Chir., Tübing., 1910, lxxviii, 205-236.
- SAVARIAUD, M.: Les accidents graves provoqués par le taxis des hernies; réduction en masse et iléus paralytique. Tribune méd., Par., 1905, n.s., xxxvii, 279.
- SAVIARD, B.: Nouveau recueil d'observations chirurgicales. Paris, J., Collombat, 1702, p. 99.
- SCARPA, A.: Sull' ernia memorie anatomico-chirurgiche. 2nd ed., Pavia, Dalla stamperia Fusi e co., success. Galeazzi, 1819.
- SCHWARTZ, A.: Les coliques douloureuses postopératoires. Paris méd., 1919, xxxiii, 411.
- SHARP, S.: A critical enquiry into the present state of surgery. Lond., Tonson & Draper, 1750, p. 21.
- SHIER, R. V. B.: Surgical postoperative treatment. Surg. Gynec. & Obst., Chi., 1921, xxxii, 559-561.
- SONNENBURG, E.: Beiträge zur Herniotomie. Deutsche Ztschr. f. Chir., Leipz., 1879-1880, xii, 299-314.
- STROMMEYER: See Sultan, G.: Abdominal hernias. English transl. ed. by W. B. Coley, Phila., W. B. Saunders Co., 1902, p. 107.
- SUNDBERG, H.: Fall av opererad embolus arteriæ femoralis. Hygiea, Stockholm, 1920, lxxxii, 1-12.
- TEXTOR: See Velpeau, A. A. L. M.: Operative surgery. English transl. by P. S. Townsend. New York, S. S. & W. Wood, 1851, iii, 702.
- THOMAS, J. W. T.: Porocephalus in a hernial sac. J. Roy. Army Med. Corps, Lond., 1920, xxxiv, 154.
- THURSTON, E. O.: Gangrenous strangulated inguinal hernia. Indian M. Gaz., Calcutta, 1904, xxxix 16.
- TRUEBLOOD, D. V.: End-to-end intestinal anastomosis. An experimental study. Northwest med., Seattle, 1923, xxii, 27-29.
- VAN ZWALLENBURG, C.: See Coley, W. B.: p. 42-43.
- VAUGHAN, G. T.: An analysis of twenty-five cases of strangulated hernia treated by operation. Virginia M. Semi-Month., Richmond, 1904-1905, ix, 409-414.
- VAUGHAN, R. T.: Incarcerated right scrotal hernia due to adherent carcinomatous omentum. Surg. Clin., Chi., 1918, ii, 641-646.
- VIDAL: See Jaboulay, M. et Patel, M.: p. 84.
- WELCH, W. H.: Thrombosis and embolism. In: Allbutt's System of Medicine. Lond., MacMillan, 1909, vi, 691-821.
- WILLIAMSON, C. S., AND MANN, F. C.: Postoperative peritoneal adhesions. Surg., Gynec., & Obst., Chi., 1922, xxxiv, 674-676.
- WILMER, B.: Practical observations on hernia. Lond., Longman & Rees, 1788.
- WILSON, R. M.: Hot floors as a preventive to shock. J. Am. Med. Assn., Chi., 1920, lxxv, 1286.
- ZEIDLER: See Hesse, E.: p. 179.

CHAPTER II

COMPLICATIONS OF STRANGULATION

The principal complications of strangulated hernia are intestinal hemorrhage, stenosis of the intestine, postoperative perforation, and volvulus of the intestine. (The other complications are those associated with nonstrangulated hernia and are discussed in the chapters on special hernias.)

INTESTINAL HEMORRHAGE (ENTERORRHAGIA)

Intestinal hemorrhage may follow attempts at taxis or the operative treatment of strangulated hernia. Schnitzler in 1894, called attention to the early appearance of enterorrhagia, and Ullmann in 1897, described delayed or latent hemorrhage. Kukula in 1900, studied the postoperative complications of enterorrhagia, and Sauvé in 1905, wrote an important paper on this subject, which contained a résumé of the literature. Cumston also published a valuable clinical paper.

Intestinal hemorrhage following strangulation is divided into two general types, namely, (a) the avoidable hemorrhages due to trauma, taxis or intestinal perforation; (b) the unavoidable hemorrhages, which are most conveniently subdivided into two varieties, namely, early intestinal hemorrhage and delayed or latent intestinal hemorrhage.

A. Early Intestinal Hemorrhage

Early intestinal hemorrhage usually occurs within the first twenty-four hours. It is seldom severe, but it indicates low vitality of the intestine with arterial ischemia that is liable to be further complicated by arterial thrombosis.

Etiology.—The generally accepted cause of early intestinal hemorrhage is a trophic disturbance in the capillaries. Following the onset of strangulation, the arterial flow is checked in the constricted loop and the capillaries undergo trophic changes and become weakened. With the reestablishment of arterial circulation, the diseased capillaries are unable to withstand the pressure and a rupture with hemorrhage takes place.

Litten, in 1875, produced intestinal hemorrhage experimentally by ligating the mesenteric artery. On removal of the ligature hemorrhage occurred, but it was easily checked by tightening the ligature. Kukula advanced the theory that the hemorrhage is due to thrombosis of the venous capillaries. This theory is not generally accepted, because the thrombosis is a complication of the hemorrhage and not a cause of it.

The principal causative factors of intestinal hemorrhage following strangulated hernia operations may be summarized as follows:

1. Ulceration of the mucosa resulting in the casting off of an eschar. This may occur occasionally, at a distance from the point of constriction.
2. The rupture of the arterial capillaries as a result of the pressure in the arteries when circulation is resumed.
3. The collection of an exudate of blood between the layers of the intestinal walls often resulting from trauma or taxis.
4. The sudden dilatation of the mesenteric arteries as circulation is resumed after a temporary occlusion (Litten).
5. Thrombosis of the mesenteric veins, causing congestion, edema, and finally hemorrhage, which is due to ulceration of the mucosa.
6. Thrombosis of the intestinal blood supply as a result of resection of the mesentery or the omentum.
7. Diseases of the herniated viscera or of the peritoneum.
8. Sympathetic reflex disturbances or vasomotor paralysis of the mesenteric nerves. This theory is of doubtful value.

Frequency.—Early intestinal hemorrhage is not encountered as frequently as delayed or late hemorrhage, although it probably occurs much oftener than statistics show, but is overlooked through failure to examine the stools, or because of the fact that a small amount of blood may be digested without being recognized, especially when the bleeding point is high up in the small intestine, or perhaps small clots of blood may be intimately mixed with the feces and escape detection unless blood tests are made.

Symptoms.—The onset of hemorrhage is usually manifested by a slight elevation in temperature followed by the appearance of blood in the stools. The bleeding may continue for several days, but is seldom profuse. When there is considerable hemorrhage, the temperature is usually subnormal and there are other symptoms of shock. Profuse hemorrhage generally occurs in voluminous hernias of long standing. Strangulation is usually of short duration—twelve to twenty-four hours—and the strangulated loop is often long.

The recovery of the patient from the strangulated hernia operation is usually only slightly delayed by the hemorrhage, although the statistics collected by Castagnol, indicate that the mortality is higher than generally supposed. When death occurs it is nearly always due to other causes, such as volvulus, perforation, pneumonia, etc. Castagnol collected from the literature 25 cases of hemorrhage after strangulated hernia operations. Of this number, 7 patients died; in 3 of these the bleeding was due to vascular occlusion. In 18 cases of early hemorrhage in this series, 4 patients died, and in 5 cases of late hemorrhage, one patient died.

B. Delayed or Latent Hemorrhage

Delayed hemorrhage usually occurs between the 4th and 16th day after operation. As a rule, the general condition of the patient up to this time is good, and apparently he is nearly well when bleeding suddenly appears without prodromal symptoms, and is often profuse. The outlook is serious.

Etiology.—Delayed hemorrhage usually occurs in elderly subjects with arteriosclerosis. The mesenteric vessels become thrombosed and an extensive hemorrhagic infarct develops in the intestinal wall. This change in non-terminal intestinal arteries was demonstrated by Litten. Bégouin produced late intestinal hemorrhage experimentally by ligating one of the small arteries supplying the intestine. The strangulation in cases of delayed hemorrhage is usually of long duration, from three to four days, according to Ullmann, Fikl, and Sauv . The strangulated loop is generally short. A majority of the cases of delayed hemorrhage are due to the late separation of a mucosa eschar, while a minority are due to a retrograde thrombosis.

As early as 1866, Nicaise demonstrated that intestinal gangrene progresses from the mucosa outward toward the serosa, and this fact was more recently confirmed by the experiments carried out by Schweninger and Tietz. When intestinal wall feels thin and is of questionable viability, it should be regarded as suspicious. The fact that the serosa is intact often causes the operator to replace damaged intestine.

The constricting grooves on the intestine show ecchymotic rings that denote the line of demarcation between the strangulated loop and the normal intestine that lies within the abdominal cavity. Thinning of the intestine in the constricted groove should be suspected when the serosa is rough, lusterless, and of grayish or dead-leaf color. The thinning cannot always be felt, as it is sometimes masked by the edema and swelling of the intestinal coats. These changes have already been described under the pathology of strangulation.

It should be borne in mind that the bleeding sometimes takes place in the intestine above the point of strangulation within the abdominal cavity. If the ulceration involves the serosa, perforation will follow, and the hemorrhage will appear in the peritoneal cavity. If the hemorrhage is high up in the intestine and complicated by partial obstruction, in rare instances, the blood will be vomited.

DIFFERENTIAL DIAGNOSIS BETWEEN EARLY AND LATE INTESTINAL HEMORRHAGE FOLLOWING STRANGULATION

	EARLY HEMORRHAGE	LATE HEMORRHAGE
Time of onset	12-48 hours	4th to 16th day
Amount of bleeding	slight	sometimes profuse
Duration of strangulation	12-24 hours	3-4 days
Constriction	usually narrow	often wide
Size of hernia	frequently of long standing and voluminous	usually small
Age	in young or adults	usually in the aged associated with arteriosclerosis
Prognosis	favorable	grave

Prognosis.—The prognosis of early hemorrhage is usually favorable because the amount of bleeding is small and it yields to palliative treatment. Delayed or late hemorrhage has a grave outlook because the bleeding is profuse, and as the condition is generally found in elderly arteriosclerotic subjects, the chances of spontaneous cure are remote. When the stools contain gangrenous scraps, often grayish and fetid, the hemorrhage will usually yield to palliative measures, providing the surgeon is certain he did not overlook a patch of gangrene in the serosa at the time of the hernia operation. Operative intervention is sometimes required and should be resorted to early before the patient is exhausted from loss of blood. Patients operated on *in extremis* usually die.

Treatment.—When the hemorrhage is not profuse, the treatment is usually palliative. A liquid or soft diet should be given to diminish peristalsis as much as possible. In severe cases nothing is given by mouth; all fluid and food being administered per rectum for several days after the blood has disappeared. To control the hemorrhage, the patient is kept quiet for two to three weeks, an opiate given to check peristalsis, an ice bag applied over the abdomen, calcium chlorid solution given by hypodermoclysis, and horse serum, ergotin or ergotol given hypodermatically. If there is diarrhea, it should be controlled by opiates to which a styptic has been added. After the hemorrhage is checked, the bowels should be moved daily with a mild laxative or a low enema.

STENOSIS OF INTESTINE

1. **Stenosis of the Intestine Following Hemorrhage.**—Stenosis of the intestine is sometimes a late complication of intestinal hemorrhage following strangulated hernia operations. The cicatrix is situated at the site of the former ulcer and may not produce symptoms until several months after the hemorrhage.

2. **Stenosis of the Intestine after Strangulation.**—Stenosis or stricture of the intestine resulting from strangulation is comparatively rare. Probably the first case was reported by Acrel in 1772. Vincent, in 1781, described an operation to counteract the harmful effects of cicatricial contraction of the intestine following strangulation. Richter, in 1785, described the condition and in more recent times Cotte and Leriche published their monograph. Other valuable papers have been contributed by Guignard, Nicaise, Garré, Thomson, Schulz, Haasler, Göbell, Francoz, Roche Cade, Rouhier and Martin, Delore and Jacob, and Moore.

Pathological Anatomy.—The constriction of the intestinal wall is usually annular or tubular in form.

1. *Annular Constriction.*—Annular constrictions are ordinarily single, but when double, they correspond to the two extremities of the strangulated loop

of intestine. The constriction furrow is narrow, and the serosa is rough, lusterless, and grayish in color.

2. *Tubular Constriction*.—Tubular constrictions are nearly always single, and are due to ulceration and cicatrization of the mucosa. In severe cases the muscular layers are also involved, and in rare instances, the serosa may undergo cicatricial changes. Tubular constrictions may be 1 to 2 inches (2.5 to 5 cm.) long, and the lumen of the intestine may be the size of the little finger, or in marked stenosis it may be so small as to admit only a probe.

In isolated cases the cicatrization is limited to the serosa and this causes constriction of the mucosa. Ulceration of the mucosa seldom develops unless there is obstruction in the blood supply.

Changes in the Intestine.—The afferent loop of intestine above the stenosis is dilated and its walls are more or less hypertrophied, especially the muscular layers. Below the constriction the efferent loop is thin, atrophied and collapsed; very much the same condition of affairs being found here that is found in strangulation.

Experimental Stenosis.—I have produced stenosis experimentally by ligating the arterial supply for a short time, always removing the ligature in less than two hours to prevent gangrene. Necrosis of the mucosa always developed with the ultimate formation of a stricture. Schloffer produced stenosis by excising a short piece of mesentery, 1 to 2 inches (2.5 to 5 cm.) in length, near the intestine.

Etiology.—Stenosis is much more frequent after strangulated inguinal hernia than after strangulated femoral hernia, in spite of the greater frequency of strangulation in the femoral variety of hernia. Of 37 cases of stenosis collected in the literature by Jaboulay and Patel, 27 were inguinal, 8 femoral, and 2 umbilical.

Stenosis may be due to interference with the blood supply, which results if an insufficient amount of mesentery is left when the intestine is resected, or if the vessels supplying the intestinal wall come from the adherent omentum and are destroyed when the adhesions are separated. If too large an area of gangrenous intestine is inverted at operation for strangulated hernia, stenosis is liable to result. Other causes are: Trauma, taxis, pinching of the intestine by a truss, the presence of foreign bodies in the sac, constricting bands adherent to the sac or abdominal wall or to other viscera, localized peritonitis, tuberculosis, mesenteric cysts and benign and malignant growths involving the intestine.

Symptoms.—The symptoms of intestinal stenosis may appear any time after attempts at taxis or operation for strangulated hernia. The patient usually does well for a few days after operation when he notices slight pains in the abdomen, occasionally associated with vomiting and some distention of the abdomen. Sometimes the symptoms appear as early as twenty-four hours after operation, or as late as several years after the strangulation.

There are two varieties of stenosis, acute and chronic:

1. *Acute Stenosis*.—In acute occlusion the symptoms are marked. Vomiting becomes frequent, abdominal distention increases, the pulse is feeble, the temperature subnormal, and breathing is labored.

2. *Chronic Stenosis*.—In chronic occlusion the symptoms appear gradually, slowly increasing in severity, as in other forms of stricture of the intestine. There is vomiting when the stomach becomes distended. The patient suffers from inanition and steadily loses weight. The abdominal distention becomes distressing until relieved by vomiting or by gas passing the obstruction, the latter being accompanied by a characteristic sound on auscultation, which Jaboulay and Patel have aptly compared to the "glou-glou" sound of a bottle being emptied of liquid.

Sign of Future Stenosis.—When the constricted loop is freed and inspected during an operation for strangulated hernia, the constricting groove or furrow should disappear if it is gently stroked with moist pledgets of cotton. Should the groove persist, it usually means that the mucosa has been destroyed and more or less obstruction will develop later on.

Prognosis.—The prognosis for stenosis of the intestine is unfavorable. The symptoms are temporarily helped by medical measures but tend to increase in severity as the stricture becomes tighter. Operative treatment is the only hope for relief and should be undertaken early before the changes in the affected intestine become too advanced, and while the patient's general condition is good.

Treatment.—Operative treatment is indicated in both acute and chronic stenosis. If the strictured portion of the intestine is very small, it is sometimes possible to excise the fibrous tissue and do a plastic operation on the intestine. As a rule, it is safer to resect the intestine well beyond the stricture and do a lateral or end-to-end anastomosis by suture. When the patient is a poor risk and a rapid operation is imperative, an anastomotic button should be used to join the intestinal ends.

When the stricture is due to adhesions, to extensive constricting bands, to mesenteric cysts or to new growths in adjacent viscera, it is useless to separate adhesions unless omentum is available to cover the raw surfaces. In these cases intestinal resection will give the patient the best results.

POSTOPERATIVE INTESTINAL PERFORATION

Postoperative intestinal perforation may occur when intestine of doubtful viability is returned to the abdominal cavity. It may take place in the loop that has been strangulated, or in the afferent loop above the constriction. The intestine may rupture as soon as it is returned to the abdominal cavity, or it may be several days afterward. In the case reported by Gibbon, perforation did not occur until three weeks after the operation for strangulated hernia.

The resistance to bacterial infection normally possessed by the mucosa is impaired or destroyed by the trophic changes it undergoes during strangulation. If the infection is limited to the mucosa, an eschar is thrown off, accompanied by more or less hemorrhage. If the entire intestinal wall is involved and it becomes necrotic, perforation results and is followed by peritonitis. Diagnosis is rarely made excepting at operation. The symptoms are the same as those associated with any form of intestinal perforation. When symptoms of peritonitis appear after a strangulated hernia operation, intestinal perforation should always be thought of.

Perforation of Intestine above the Constriction (Proximal Ulceration of Intestinal Obstruction).—Perforation of the afferent portion of intestine above the constriction in the abdominal cavity is a rare complication of strangulated hernia. The circulatory and trophic changes of the afferent loop of intestine have been discussed under the pathology of strangulated hernia and also under the heading of intestinal hemorrhage.

Sellenings reported two cases in which the perforation occurred within the abdominal cavity, 8 to 10 inches (20 to 25 cm.) above the point of constriction of the hernia. Lerat and Ertaud reported a case of strangulated hernia in which the constricted loop was viable and was returned to the abdominal cavity. The afferent loop above the constriction was not examined. Symptoms of intestinal perforation developed eight hours after operation, the abdomen was opened, and a rent was found in the afferent loop.

Brewer reported a case of strangulated femoral hernia in a woman, who, twenty-four hours after operation, developed peritonitis and died suddenly. At autopsy a perforation was found in the afferent ileum, 7 inches (17.5 cm.) above the constriction.

Prognosis.—If the intestinal rent is small and adhesions have time to form and localize the peritonitis, the outlook is fairly good. Should the peritonitis become general, the prognosis is grave and unless operation is resorted to promptly, the patient usually dies.

Treatment.—The treatment for postoperative intestinal perforation is a prompt exploratory laparotomy. The rent in the intestine must be found and closed. The intestinal suture line should be protected by a flap of omentum if it is available, the wound closed with drainage, the patient placed in the Fowler position and treated for peritonitis.

VOLVULUS OF THE INTESTINE COMPLICATING STRANGULATED HERNIA

Volvulus is a rare complication of strangulated hernia, and is almost always associated with inguinal hernia. However, a few cases of the umbilical, obturator and femoral varieties have been reported in the literature.

Anatomic Varieties.—Knaggs divided volvulus complicating strangulated hernia into four groups:

1. Volvulus of a portion or of all the herniated intestine.
2. Volvulus of the small intestine with one loop in the hernia.
3. Volvulus of the herniated bowel, occurring immediately after its reduction.
4. Volvulus of the herniated bowel occurring some time after its reduction.

Miller added two more groups:

5. Volvulus of a distant afferent loop above a strangulated hernia.
6. Volvulus, generally of the large intestine, distal to a simulated strangulated hernia.

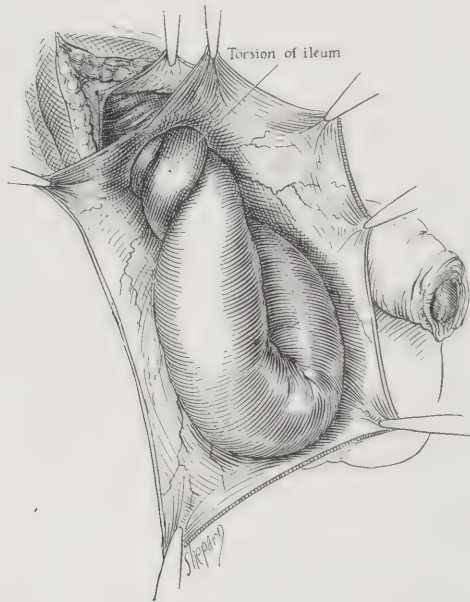


Fig. 17.—Volvulus of the intestine in a hernial sac.

Degree of Torsion.—Symptoms of volvulus may be produced by a quarter twist (90 degrees), a half turn (180 degrees), or a complete twist (360 degrees). Very rarely the loop may rotate more than 360 degrees. (Fig. 17.)

Etiology.—Volvulus or torsion of the intestine seldom occurs except in inguinal hernia, and is almost always found in subjects of middle or advanced age. It is frequently due to the continual movement of the nonadherent intestine in the sac, and may rarely be caused by the presence of benign or malignant growths. It is often aggravated by the pressure of a truss or by trauma. Acute volvulus is sometimes due to attempts at taxis. Torsion of the intestine is sometimes complicated by twisting of the omentum.

Symptoms.—The symptoms of intestinal volvulus in strangulated hernia are usually of sudden onset, and their severity is out of proportion to those ordinarily expected in strangulation. Shock, prostration and collapse are

usually extreme from the beginning, and there is nearly always pain and tenderness referred to the hernia, which has recently become irreducible. There is severe abdominal pain and often tenderness over the abdomen above the hernia.

Owing to the similarity in the symptoms, intestinal volvulus is nearly always mistaken for acute intestinal obstruction, and is very seldom diagnosed before operation. The fact that the volvulus may be some distance above the sac in the abdominal cavity should put the surgeon on his guard, and if the condition found in the sac does not account fully for the symptoms, the intestine above the constricting ring must be examined by drawing it down into the wound, or by making a supplemental incision.

Whenever the symptoms of obstruction persist after an apparently successful operation for strangulated hernia, no time should be lost in performing an exploratory laparotomy to search for an intraabdominal torsion above the hernia. Unless the obstruction is found promptly and relieved, the patient will die.

Prognosis.—The prognosis for volvulus complicating strangulated hernia is grave. The danger lies in the possibility of the volvulus being overlooked at the time of the operation for the strangulation.

Treatment.—Immediate operation is the only treatment for volvulus complicating strangulated hernia. The twisted loop must be found, the torsion relieved, and suitable precautions taken against its recurrence. A good plan is to attach the intestine or its mesentery to the parietal peritoneum or to the omentum, with two to four sutures. If the intestine is gangrenous, resection is indicated. If the patient's condition is critical, his life may be saved by a two-stage operation, limiting the first one to fastening the necrotic loop in the wound, draining the intestine, and forming an artificial anus.

Clarke reported an interesting case of volvulus in a man, aged 61, with double irreducible inguinal hernia, and symptoms of obstruction. A midline incision was made, as it was uncertain which hernia was producing the symptoms. A volvulus of the intestine was found on the right side and only irreducible omentum was on the left side. I observed a case in which strangulation in the hernial sac was caused by an intraabdominal volvulus.

Bibliography

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- ACREL, O.: *Chirurgische Geschichte*. Lübeck und Leipzig, C. D. Donatius, 1772, p. 163.
 BÉGOUIN, P.: See Sauvé, L.: p. 497.
 BREWER, G. E.: Follicular perforation of the ileum. *Ann. Surg., Phila.*, 1900, xxxi, 259-260.
 CADE, A., ROUBIER, C., AND MARTIN, J. F.: Les sténoses non néoplasiques du côlon sigmoïdien et leurs relations avec le mégacôlon. *Lyon chirurg.*, 1913, x, 1-22.
 CASTAGNOL, E.: Des entérorrhagies herniaires. Thèse, Bordeaux, 1901.
 CLARKE, J.: Herniotomy and laparotomy; strangulated hernia and secondary volvulus of the small intestine. *Med. Press & Circ., Lond.*, 1906, n.s. lxxi, 471-472.
 COTTE, G., AND LERICHE, R.: Des sténoses intestinales tardives consécutives à l'étranglement herniaire. *Rev. de gynéc. et de chir. abd., Par.*, 1905, ix, 255-296.

- CUMSTON, C. G.: Enterorrhagia in hernia. *Internat. Clin., Phila.*, 1921, 31. s., i, 38-45.
- DELORE, X., AND JACOB, M.: Rétrécissement intrinsèque de l'intestin grêle consécutif à un étranglement herniaire. *Lyon méd.*, 1904, ciii, 669-705.
- FIKL, A.: Ein Falle von Darmblutung nach Herniotomie. *Wien. klin. Wehnschr.*, 1895, viii, 474-475.
- FRANCOZ, C.: Rétrécissements de l'intestin grêle consécutifs aux hernies étranglées. Thèse, Lyon, 1899.
- GARRÉ, C.: Ueber eine eigenartige Form von narbiger Darmstenose nach Brucheinklemmung. *Beitr. z. klin. Chir., Tübing.*, 1892, ix, 187-197.
- GIBBON, J. H.: Intestinal perforation producing peritonitis and obstruction three weeks after operation for strangulated hernia; resection of bowel; recovery. *Ann. Surg., Phila.*, 1903, xxxviii, 132-136.
- GÖBEL, R.: Ueber die Darmstenose nach Brucheinklemmung. *Deutsche Ztschr. f. Chir., Leipz.*, 1902, lxvii, 578-590.
- GUIGNARD, P. E.: Du rétrécissement et de l'oblitération de l'intestin dans les hernies. Thèse, Paris, 1846.
- HAASLER: Ueber Darmstenose. *Arch. f. klin. Chir., Berl.*, 1903, lxxi, 652-663.
- JABOULAY, M., AND PATEL, M.: Hernies. xxv Nouveau traité de chirurgie. Le Dentu, A. et Delbet, P., Paris, Baillière, 1908.
- KNAGGS, R. L.: On volvulus in association with hernia. *Ann. Surg., Phila.*, 1900, xxxi, 405-430.
- KUKULA: L'étiologie des enterorrhagies consécutives à l'étranglement des hernies. *Ann. Soc. belge de chir., Brux.*, 1899, vii, 190-228.
- LERAT, H., AND ERTAUD, E.: Hernie crurale étranglée; cure radicale; perforation intestinale huit jours après l'intervention (etc.). *Gaz. méd. de Nantes*, 1913, 2, s., xxxi, 81-93.
- LITTEN, M.: Ueber die Folgen des Verschlusses der Arteria mesaraica superior. *Arch. f. path. Anat. (etc.) Berl.*, 1875, lxiii, 289-321.
- MILLER, R. T. JR.: On the coincidence of volvulus and real or simulated strangulated hernia. *Ann. Surg., Phila.*, 1911, liii, 232-249.
- MOORE, C. A.: Hypertrophic fibrosis of the gut causing chronic obstruction; a sequel to a strangulated hernia. *Brit. J. Surg., Bristol*, 1913-1914, i, 361-365.
- NICAISE, E.: Sur une variété de rétrécissement de l'intestin consécutif à un étranglement herniaire. *Rev. de chir., Par.*, 1881, i, 257-265.
- RICHTER, A. G.: Abhandlung von den Bruchen. Göttingen, J. C. Dieterich, 1785.
- ROCHE, L.: Sténoses intestinales tardives consécutives à l'étranglement herniaire. Thèse, Lyon, 1906.
- SAUVÉ, L.: Des hémorrhagies intestinales consécutives à l'opération des hernies en général. *Rev. de chir., Par.*, 1905, xxxi, 211-255; 363-382; 492-507.
- SCHLOFFER, H.: Ueber Darmstrikturen nach Unterbrechung der mesenterialen Blutzufuhr. *Mitt. a. d. Grenzgeb. d. Med. u. Chir., Jena*, 1904-1905, xiv, 251-274.
- SCHNITZLER, J.: Ueber Darmblutungen nach Reposition incarcerirter Hernien. *Internat. klin. Rundschau, Wien*, 1894, viii, 487-490.
- SCHULZ, J.: Ueber Darmstenose infolge von Gangrän der Schleimhaut nach Incarceration von Hernien (etc.). *Deutsche Ztschr. f. Chir., Leipz.*, 1897-1898, xlvii, 561-574.
- SCHWENINGER, F.: Experimentelle Studien über Darm-Einklemmung. *Arch. f. Heilkunde, Leipz.*, 1873, xiv, 300-347.
- SELLENINGS, A. E.: Solitary perforation of the ileum ("proximal ulceration of intestinal obstruction") associated with strangulated and obstructed herniae. Report of two cases with recovery. *Am. J. Surg., N. Y.*, 1910, xxiv, 321-323.
- THOMSON, A.: Stricture of the intestine; a sequel of strangulated hernia. *Brit. M. J., Lond.*, 1897, ii, 950-952.
- TIETZ, A.: Klinische und experimentelle Beiträge zur Lehre von der Darmincarceration. *Arch. f. klin. Chir., Berl.*, 1894-1895, xlix, 111-166.
- ULLMANN, E.: Ueber Darmblutungen nach Herniotomien. *Wien. med. Wehnschr.*, 1897, xlvii, 951-955.
- VINCENT: See Cotte, G. et Leriche, R.: p. 255.

CHAPTER III

PARTIAL ENTEROCELE

Synonyms.—Richter's hernia; Nipped hernia; Masked hernia; Lateral pinching of the intestine; Lavater's hernia; Incorrectly called Littré's hernia.

Definition.—A partial enterocele is a strangulated hernia in which only a part of the circumference of the intestine is caught in the constricting ring.

Historical

Partial enterocele was first observed by Fabricius Hildanus in 1598, and was clearly described by Lavater in 1672. Cases were reported by Littré, in 1700 and 1714; Morgagni, in 1723; de Garengéot, in 1743; Ruysch, in 1744, and others. The most important of the early papers was published in 1785 by Richter, from whom this hernia takes the name often applied to it. Later papers were contributed by Meckel, Riecke, Wagner, Defaut, Treves, De Beaumais, Adam, and Vires, who collected 96 cases in the literature; Jones, Collins, Delage, Riedel, and Sawyer.

Pathological Changes.—In partial enterocele the constricted portion of intestine becomes distended and swollen, and it may retain its deformity some time after the constriction is relieved, presenting the appearance of a diverticulum. This false diverticulum of partial enterocele gave rise to considerable confusion among the early writers. Even Littré mistook his two cases of hernia of Meckel's diverticulum for hernias of the intestinal wall. The changes that take place in the constricted intestine are due to the cutting off of its blood supply and to the distention of the intestine. The dilatation of the constricted intestine is always secondary to the onset of the strangulation. (Fig. 18.)

Gangrene occurs earlier in partial enterocele than in ordinary strangulation. This fact is undoubtedly due to the direct pressure exerted on the intestine by the constricting ring. In ordinary enterocele the mesentery or omentum, on account of its elasticity, acts as a cushion or buffer and thus delays the onset of strangulation. In partial enterocele the convex surface of the loop, which is the free border opposite the mesentery, is the portion of the intestine that strangulates. The mesentery does not enter the hernial sac, and for this reason, Roser in 1886, denied the existence of partial strangulation of the intestine.

Etiology

When intestine is adherent to the sac wall a sudden increase in intra-abdominal pressure may force the sac with its attached intestine through the constricting ring. A partial enterocele is most frequent in femoral, obturator,

and inguinal hernias; in rare instances it is found in the umbilical, ventral, and sciatic varieties. Sawyer and Baldwin reported cases in which strangulation occurred in postoperative ventral hernias. Arnold reported a case of fracture of the pelvis in a woman, aged 76 years, in which a portion of the intestine was nipped by the bony fragments of the horizontal ramus of the pubis. Considerable force was required to liberate the lacerated intestine.

Symptoms

The symptoms of partial enterocele are similar to those described for strangulation of the entire intestine, with the exception that in partial enterocele constipation is not complete, some fecal matter and gas can pass the constriction in nearly all cases; vomiting is usually absent, and when present it seldom becomes fecal in character.

Local signs are often absent. If a swelling can be detected in the femoral or inguinal region, a diagnosis is easy. Treves stated that the tumor is absent in 50 per cent of the cases. In the majority, however, no tumor can

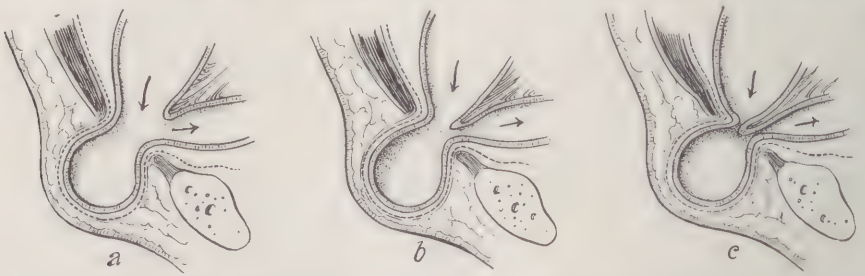


Fig. 18.—Partial enterocele. The various degrees of strangulation depend on the amount of the convex surface of the loop in the sac.

be detected and the pain and tenderness over the strangulated hernia may be so slight as to pass unnoticed, even by the patient himself.

A partial enterocele in the femoral or inguinal region is often mistaken for an inflamed lymphatic gland, especially when the condition is accompanied by tenderness, a degree or two of fever, and the typical symptoms of strangulation are lacking. Perforation into the sac may take place without serious symptoms developing.

Prognosis

The prognosis for strangulated partial enterocele is grave, because gangrene develops early and operation is usually undertaken late, on account of the mildness of the symptoms which may delay diagnosis. The mortality rate is higher than in ordinary strangulated hernia.

Treatment

The treatment for strangulated partial enterocele is the same as for other forms of strangulated hernia. Early operation is imperative. A small, tender, painful mass at one of the hernial openings, if accompanied by only

moderate gastrointestinal symptoms, should be regarded with suspicion and treated by prompt operation without preliminary attempts at taxis.

If the intestine is viable and no constricting furrow is seen, the intestine can be returned to the abdominal cavity. If there is gangrene, perforation or signs of doubtful viability, the intestine should always be resected, unless the gangrenous area is very small, when it may be turned in and buried under a few Lembert sutures. Large patches of gangrene should never be inverted because of the danger of postoperative stenosis. When the patient's condition is grave, it is often best to do two operations, limiting the first one to bringing the intestine into the wound and forming a fecal fistula, and closing the fistula and repairing the hernia at the second operation.

Operation by the abdominal route is often to be advised as a time-saver in strangulated partial enterocele in the femoral, obturator, or sciatic regions.

(For additional details on the treatment of strangulated hernia, see the chapters on special hernias and the treatment of ordinary strangulated hernia.)

Bibliography

PARTIAL ENTEROCELE

- ARNOLD, G. J.: A case of fracture of the pelvis from slight violence, with nipping of small intestine between the fragments, causing acute intestinal obstruction and general peritonitis. *Lancet*, Lond., 1907, i, 1157-1158.
- BALDWIN, J. H.: Acute partial enterocele in a postoperative hernia. *Surg. Gynec. & Obst.*, Chi., 1922, xxxiv, 415.
- COLLINS, W. J.: Three cases of unusual hernia; herniotomy; recovery. *Lancet*, Lond., 1903, i, 1444-1445.
- DE BEAUMAIS, R. A.: Étude sur l'étranglement herniaire par pincement latéral de l'intestin. Thèse, Paris, 1889.
- DEFAUT, J. J.: Contribution à l'étude clinique du pincement latéral de l'intestin avec persistance du cours des matières. Thèse, Paris, 1879.
- DELAGE, J.: Du pincement latéral de l'intestin dans les hernies étranglées. *Rev. de chir.*, Par., 1907, xxxv, 404-418.
- FABRICIUS (HILDANUS) G.: Observatorium et curationum chirurgicarum. In: *Thesaurus chirurgiæ*, (P. Uffenbachium), Francofurti, N. Hoffmanni, 1610, p. 1108.
- DE GARENGEOT, R. J. C.: Traité des opérations de chirurgie. 2nd ed., Paris, Huart, 1731, i, 229-385.
- JONES, T. C. L.: Partial enterocele, strangulated. *Lancet*, Lond., 1904, i, 1280.
- LAVATER, J. H.: De intestinorum compressione. Basileæ, 1672. In: *Haller's Disputationes chirurgicæ selectæ*. Lausannæ, Bousquet, 1755, iii, 39-62.
- LITTRÉ, A.: Observation sur une nouvelle espèce de hernie. *Mém. de l'acad. roy. des Sciences*, Par., 1700, p. 300; 1714, p. 200.
- MECKEL, J. F.: *Handbuch der Menschlichen Anatomie*. Halle u. Berl., 1820, iv, 666-672.
- MORGAGNI, J. B.: *Adversaria anatomica omnia*. Lugduni, J. A. Langerak, 1723, iii, 8-9.
- RICHTER, A. G.: *Abhandlung von den Bruchen*. Göttingen, J. C. Dieterich, 1785.
- RIECKE, K. F.: *Ueber Darm-Anhangs-Bruche (Hernia littriciæ)*. Berlin, A. Hirschwald, 1841.
- RIEDEL: Die Einklemmung einer kurzen Darmschlinge im inneren Leisten-resp. Schenkelringe. *Deutsche med. Wehnschr.*, Leipz., 1910, xxxvi, 11-13.
- ROSER, W.: *Ueber Darmwandbrüche*. *Arch. f. klin. Chir.*, Berl., 1886-87, xxxiv, 435-440.
- RUYSCH, F.: *Observatorium anatomico-chirurgicarum*. Amstelodami, Henricum et Viduam T. Boom, 1691.
- SAWYER, C. F.: Acute partial enterocele. *Surg. Gynec. & Obst.*, Chi., 1921, xxxiii, 38-40.
- TREVES, F.: Richter's hernia or partial enterocele. *Med. Chir. Tr.*, Lond., 1887, lii, 149-167.
- VIRES, J.: Du pincement latéral de l'intestin dans les hernies. *N. Montpel. méd.*, Suppl., 1897, vi, 99; 201; 341; 407.
- WAGNER, E.: Beiderseitige Hernie des Foramen ovale; Einklemmung und beginnender Brand rechterseits. *Arch. f. physiol. Heilk.*, Stuttg., 1859, n. f. 3, 133-134.

CHAPTER IV

HERNIAL TUBERCULOSIS

Hernial tuberculosis is a term applied to tuberculosis of the hernial sac, its contents, or both.

The first case of hernial tuberculosis was observed by Baron in 1819; the second one was recorded by Pitha in 1845; and Cruveilhier in 1862, reported 2 cases of tuberculosis of the sac, and another one in which both the sac and its mesenteric contents were involved. Later cases were reported by Hayem in 1871, and Lejars in 1889. In 1891 Jonnesco collected 11 cases from the literature; Antonelli in 1889 found 80 cases, and Cotte in 1906 was able to collect 136 cases. In 1909 Segré found 167 cases and added two of his own. In 1923 I collected from the literature 222 cases of hernial tuberculosis.

Pathologic Anatomy

If viscera are in the sac, the tuberculosis ordinarily involves both the sac wall and contents. In children the hernial sac is usually empty, and for this reason most of the reported cases in these subjects have been tuberculosis of the sac wall. In adults the sac often contains viscera, and in these patients both the sac and contents are generally involved. In 23 of the cases collected by Segré, the tuberculosis was limited to the sac wall.

The Sac.—When the sac wall is the seat of tuberculosis, the entire peritoneal surface is usually affected. The involvement of only a portion of the sac is comparatively rare. Cases of localized tuberculosis of the neck of the sac have been reported by Brissaud, Guinon, Jonnesco, and Remedi. Jonnesco, Mitchell, and others have reported cases in which only the fundus of the sac was involved.

Varieties of Hernial Tuberculosis

The varieties of hernial tuberculosis are the same as those of the abdominal cavity. In fact, this condition is usually an extension from a focus of infection of the abdominal peritoneum, as fluid in the abdominal cavity gravitates downward early in the course of the disease, infecting the hernial sac.

There are three varieties of hernial tuberculosis:

1. Miliary.
2. Ulcero-caseous.
3. Fibrous.

1. Miliary.—The miliary form is the most common. The interior of the sac is studded with small miliary tubercles, which may be isolated or grouped

close together. The sac nearly always contains more or less fluid which has the appearance of ascitic fluid; in fact, it often comes from the abdominal cavity and simply accumulates in the sac, which occupies a dependent position.

2. **Ultero-caseus.**—In the ultero-caseous variety, the sac wall is generally covered by a thick, tough membrane and sometimes tuberculous granulations. Ulceration may develop and terminate in a tuberculous abscess. At this stage of the disease, if viscera are in the sac they are involved by the tuberculous process.

3. **Fibrous.**—The fibrous type of hernial tuberculosis is rare. It nearly always develops from the miliary or ultero-caseous varieties, and generally represents the stage of healing—the so-called tuberculous cicatrix. The fibrous nodules or scar tissue are often extensively adherent to the sac contents, to the cord structures in inguinal hernia, and to the sheath of the femoral vein in femoral hernia.

The Hernial Contents.—Any abdominal viscus that enters a hernial sac may be affected by tuberculosis. The contents most frequently involved are omentum, mesentery, small intestine, genital organs, and occasionally the large intestine.

1. *The Intestine.*—Tuberculosis of the intestine is usually of the miliary variety. It may terminate in the ultero-caseous form, and abscesses may develop between the intestinal coils, the omentum, and the sac wall.

2. *The Omentum.*—Hernial tuberculosis of the omentum is seldom seen in children. Cases have been reported by Roth and Carle. It is frequent in adults, and appears as small diffuse tubercles scattered over the omentum; it has been compared to tapioca-like granulations. There is nearly always fluid in the sac, the amount depending on the severity of the infection. The omentum is usually adherent to the sac wall, but rarely to the intestine. Colle and Petit reported a case in which tuberculosis of the adherent omentum was mistaken for a hernial lipoma, and a correct diagnosis was possible only after a microscopical examination.

The Genital Organs.—Tuberculosis of the genital organs frequently co-exists with hernial tuberculosis, and it is often the primary infection. Cases of tuberculosis of the fallopian tube have been reported. Puech observed a tuberculous ovary.

Broca reported a case in a man, in which the scrotal swelling contained a hydrocele, a cyst of the cord, and a tuberculous hernial sac. Other combinations have been noted in which the peritoneal diverticulum was divided into loculi or partitions by the adhesions.

Multiple Lesions.—Multiple lesions are common in hernial tuberculosis. As a rule, omentum, intestine, and sac wall are involved along with the testicle, or with the ovary and tube. The abdominal peritoneum is involved more commonly than is generally supposed. In fact, it is the usual primary site of the infection, and is nearly always overlooked by the operator unless

he has occasion to examine the intestine lying above the hernia or finds it necessary to open the abdomen to complete the hernia operation.

Etiology

Hernial tuberculosis is usually due to an extension downward of abdominal peritoneal tuberculosis. It is an easy matter for ascitic fluid to gravitate downward, carrying tubercle bacilli into an open inguinal or femoral hernial sac. Primary hernial tuberculosis probably does occur, as maintained by Jonnesco and Lejars; however, Morrison stated that it has never been demonstrated at postmortem examination.

An extension of an abdominal tuberculous process is the most frequent cause of hernial tuberculosis (in 70 per cent of the cases, according to Cotte), and genital tuberculosis is next in frequency as a cause. As in intestinal tuberculosis, the route of infection when not by direct extension, is probably through the blood stream or through the lymphatics, as a result of metastases.

Frequency.—Hernial tuberculosis is much more frequent than the older statistics show. It is probably present in about 1 per cent of all cases of hernia.

(ALL AGES)	TOTAL NUMBER OF HERNIAS	CASES OF HERNIAL TUBERCULOSIS
Velo	700	8
Sordina	500	5
Hilgenreiner	770	3
Remedi	338	4
Cavazzini	1,000	4

Age.—The percentage is highest in children. Morrison placed it at 2 per cent. It is somewhat lower in the aged, and lowest in adults and the middle-aged.

In 205 cases I collected from the literature, the ages were as follows:

Under 10 years	83 cases
10-20 “	37 “
20-40 “	54 “
Over 40 “	31 “
	<hr/> 205

(IN CHILDREN)	TOTAL NUMBER OF HERNIAS	CASES OF HERNIAL TUBERCULOSIS
Broca	900	15
Coley	4,571	26

Sex.—Hernial tuberculosis is three times more frequent in males than in females. This is probably due to the fact that hernial tuberculosis attacks inguinal hernia more than any other variety, and this hernia is by far the most common in males.

Duration and Size of Hernia.—The duration of the hernia and its size have no apparent bearing on the onset of tuberculosis. It has been found in hernias of all sizes.

Site of the Hernia.—Hernial tuberculosis nearly always occurs in inguinal hernia. In the cases I collected from the literature, the site was as follows:

Inguinal	173
Femoral	14
Umbilical	5
Double inguinal hernia	20
Double femoral hernia	1
Right inguinal and left femoral	1

Previous Health of the Patient.—A careful history and thorough examination of the patient will nearly always demonstrate active or healed tuberculous lesions in other parts of the body. The lesions generally associated with hernial tuberculosis are visceral and abdominal, peritoneal; genital, including testis, epididymis, tube and ovary; pulmonary and laryngeal, and bone and joint.

Symptoms

Hernial tuberculosis is conveniently divided into two varieties, painful and latent:

1. **Painful or Inflammatory Type.**—In painful hernial tuberculosis, attention is first attracted to the hernia by a severe and continuous pain limited to the hernial tumor, and referred to the abdomen only in rare instances. The hernia tends to increase in size and become irreducible. Sometimes hard irregular nodules can be detected in the sac contents. In infants and young children there is often a congenital tuberculous hydrocele.

The general symptoms of tuberculosis to be looked for are loss of weight, an evening temperature and night sweats. The presence of lesions in other parts of the body tends to confirm a diagnosis, and the tuberculin test is helpful.

2. **Latent Type.**—The latent form of hernial tuberculosis produces no symptoms and is seldom diagnosed, except at operation.

Clinical Forms.—The most frequent clinical varieties of hernial tuberculosis, according to Jaboulay and Patel, are hernio-peritoneal, hernio-testicular, and congenital tuberculous hydrocele.

a. *Hernio-Peritoneal.*—In hernio-peritoneal tuberculosis the principal symptoms—pain, distention and ascites—are referred to the abdominal peritoneum. The ascitic fluid in the sac can often be reduced into the abdominal cavity.

b. *Hernio-Testicular.*—In hernio-testicular tuberculosis, the process involves the testis and also the epididymis in most of the cases. In the early

stage, the testis is painful and indurated; later in the disease an abscess usually develops.

c. *Congenital Tuberculous Hydrocele*.—Congenital tuberculous hydrocele is frequent in hernial tuberculosis in infants and children. In its early stage it is often mistaken for an ordinary hydrocele.

Complications.—The complications of hernial tuberculosis are local and general. The local complications are those common to all hernias, namely, irreducibility, obstruction, congestion, inflammation, strangulation, etc. The general complications are tuberculous lesions in other parts of the body, in the abdominal viscera and peritoneum, genital organs, spine, bones, joints, lungs, and meninges.

Differential Diagnosis

The diagnosis of hernial tuberculosis is often difficult, and unless the personal history is suggestive or lesions exist elsewhere, it may be impossible except at operation. The ordinary conditions to be distinguished from hernial tuberculosis are nontuberculous hernial peritonitis, epiploitis, and benign or malignant growths in the sac.

Prognosis

The outlook for patients with hernial tuberculosis is grave. The local tuberculosis in the sac often clears up after operation, but the patient usually dies from the effects of the primary lesion. In my series of 222 cases, 179 patients were treated by operation, and 9 died within a week.

In 27 cases of hernial tuberculosis in children reported by Morrison, 3 patients died of general tuberculosis, and 3 others were ill at the time of his report—one with meningitis, and 2 with tuberculous enteritis. Many could not be traced.

The operation for hernial tuberculosis is attended with little additional risk, and the only contraindication to it is the presence of general tuberculosis, and even then operation is imperative should strangulation occur. The reason for the grave prognosis in hernial and peritoneal tuberculosis is the marked tendency of the disease to extend, by metastasis, to other portions of the body; complications such as abscess formation, pulmonary tuberculosis and meningitis often follow, and are the cause of death.

Treatment

The treatment of hernial tuberculosis differs very little from that of hernias in general. Often extensive adhesions are encountered during operation, and it is sometimes necessary to leave a portion of the sac on account of inseparable adhesions between it and the cord structures, epididymis, testis, blood vessels, etc.

Omentum should not be excised unless the diseased area can be com-

pletely removed, or unless resection is required to deal with adhesions. The sac should always be freely opened to obtain the benefits of air, light, and congestion or irritation of the peritoneum. Statistics show that a much higher percentage of cures follows this treatment than simple puncture and aspiration of the cystic fluid. Peritoneal tuberculosis is nearly always present also, and should be dealt with through a second incision in the midline or in the lateral rectus region.

If ulceration or stricture of the intestine has developed, resection of the intestine is indicated. In addition to the operative treatment, the usual measures employed to combat tuberculosis are necessary.

Bibliography

HERNIAL TUBERCULOSIS

- ADAM, A.: Du pincement latéral de l'intestin. Paris, G. Steinhiel, 1895.
- ANTONELLI, I.: La tubercolosi erniaria. Riv. veneta di sc. med., Venezia, 1899, xxx, 145-157; 206-219; 241-251; 289-302; 352-367; 385-397; 465-469; 494-509.
- BARON, J.: An enquiry illustrating the nature of tuberculated accretions of serous membranes. London, Longman, Hurst, Rees, Orme & Brown, 1819.
- BRISSAUD: See Hanot, V.: Des rapports de l'inflammation avec la tuberculose, Thèse de concours, Paris, 1883.
- BROCA, A.: See Cotte, G.: p. 1024.
- CARLE: See Cotte, G.: p. 1010-1011.
- CAVAZZINI: See Cotte, G.: p. 1024.
- COLEY, W. B.: Hernia. Progr. Med., Phila., Lea & Febiger, 1916, ii, 51-52.
- COLLE, J., AND PETIT: Épiplocèle tuberculeuse. Echo méd. du nord, Lille, 1905, ix, 208-210.
- COTTE, G.: Tuberculose herniaire et vagino-péritonéale. Rev. de gynéc. et de chir. abd., Par., 1906, x, 981-1056.
- CRUVEILHIER, J.: Traité d'anatomie pathologique. Paris, Baillière, 1862, iv, 667-671.
- GUINON: See Jonnesco, T.: p. 465.
- HAYEM: Discussion. Bull. Soc. anat. de Par., 1871, xlv, 33.
- HILGENREINER, H.: Bericht über 828 operativ behandelte Hernien. Beitr. z. klin., Chir., Tübing., 1903-1904, xli, 373-445.
- JABOULAY, M., AND PATEL, M.: Hernies. xxv Nouveau traité de chirurgie, Le Dentu, A. et Delbet, P., Paris, Baillière, 1908.
- JONNESCO, T.: Tuberculose herniaire. Rev. de chir., Par., 1891, xi, 185-198; 455-488.
- LEJARS, F.: Néoplasmes herniaires et péri-herniaires. Gaz. d. hôp., Par., 1889, lxii, 801-811.
- MITCHELL, J. F.: Tuberculosis of hernial sac. Johns Hopkins Hosp. Bull., Balt., 1902, xiii, 249-250.
- MORRISON, J. T.: Tuberculosis of the hernial sac; some points in its pathology and clinical course. Clin. J. Lond., 1914, xliii, 609-612.
- PITHA: Ein Beitrag zur Diagnostik und Pathologie der eingeklemmten Hernien. Vrtljschr. f. d. prakt. Heilk., Prag., 1845, iv, 48-63.
- PUECH, A.: Nouvelles recherches sur les hernies de l'ovaire. Ann. de gynéc. et d'obst., Par., 1878, x, 321-338.
- REMEDY, V.: See Cotte, G.: p. 1024.
- ROTH, K.: Ueber Hernien-Tuberkulose. I. D., Tübing., 1896.
- SEGRÉ, M.: Sulla tubercolosi erniaria. Clin. chir., Milano, 1909, xvii, 2158-2191.
- SORDINA: See Jaboulay, M. et Patel, M.: p. 129.
- VELO: See Cotte, G.: p. 1011.

CHAPTER V

HERNIA AND VOLVULUS OF THE OMENTUM

OMENTAL HERNIA

Synonyms.—Omentoceles; Epiplocele; Epiploic hernia. *Hernia zirkalis*.

Definition.—Omental hernia is a protrusion of omentum through a normal or abnormal opening in the abdominal wall.

The frequency with which omentum is found in a hernial sac increases with age. In infants and children the omentum is small, short and incompletely developed, and for this reason it does not often enter the sac. In adults, omentum is commonly in the sac, and in the aged, it is nearly always present. It is usually associated with other viscera, such as the small or large intestine, the bladder, genital organs, etc.

In this chapter, the omentum is considered as the sole hernial content. Omental hernias may be reducible, irreducible, inflamed, or strangulated. The variety is designated by the name of the region in which the hernia occurs. Omental hernias are common in the umbilical, ventral, inguinal, and femoral regions, and in the linea alba. Isolated omental hernias are usually small, seldom larger than a hen's egg, and are nearly always oval, elongated and cylindrical in shape; infrequently they are globular in form.

Massive omental hernias often drag on the stomach and transverse colon, producing severe gastrointestinal symptoms.

Symptoms and Diagnosis

The functional symptoms of omental hernia are similar to those described for intestinal hernias, but they are milder. The objective signs are as follows: On palpation, the tumor is soft and yielding, but not elastic. Often the irregular lobular surface can be felt. The mass reduces more slowly than intestine, without gurgling and with little or no pain. There is dullness on percussion, and the impulse on coughing is less pronounced than in intestinal hernia.

Inflammation of the Omentum.—Chronic epiploitis usually occurs in old voluminous hernias that are irreducible or controlled only with difficulty. The omentum changes into a hard, irregular, nodular mass, which often is irreducible on account of the adhesions, and because of the fat it accumulates after it enters the hernial sac. Adhesions to the sac wall are common, especially as a result of trauma from the wearing of a truss. Sometimes the omentum is spread out in the sac and becomes adherent by its outer surface to the sac wall, in this manner forming a second sac or epiploic sac.

At operation it is necessary to divide the omentum to expose the intestine. Inflamed hernias are due to continued trauma, to contusions, because of the exposed position of the swelling and to irritation from a truss, etc. When infection occurs, it is probably through the blood stream.

Irreducibility.—Old omental hernias are often subject to attacks of temporary irreducibility when the hernia becomes swollen, tender and painful. Each attack is followed by additional adhesions, an increase in the size of the hernia and greater difficulty in reduction. Pipelet, in 1774, called attention to the prominence of gastrointestinal symptoms in omental hernia, especially when it is irreducible.

Strangulation of Omentum.—The inflammatory stage is followed by congestion, edema and swelling of the omentum. The vein walls dilate, congestion appears, the fat loses its clear yellow color and becomes pale, opaque and pasty. Lymph exudates form on the surface of the omentum and the edema causes the separate lobules of fat to become adherent to each other.

Gangrene of the strangulated omentum is uncommon, because less blood is required to maintain the viability of omentum than is necessary for intestine. On account of the lowered vitality, the fat is often the seat of inflammation that sometimes terminates in suppurative epiploitis. If the mass is examined carefully, a small gangrenous area is often found in its interior. If the neck of the sac is open, the infection undoubtedly comes from the peritoneal cavity in certain cases.

Symptoms of Strangulation.—The symptoms of strangulated omentum are similar to those of strangulated partial enterocele. The vomiting is not severe; sometimes it is absent and intestinal obstruction is not complete. The hernia is irreducible, somewhat painful on pressure, hard, nodular, nonfluctuating, and dull on percussion. Strangulation often continues for one to two weeks and the patient does not seek medical attention until suppuration develops with pain, fever, and other symptoms of hernial peritonitis. Should the peritonitis extend to the abdominal cavity the prognosis is grave.

Prognosis

The prognosis for inflamed and strangulated epiploceles is good, providing the infection remains localized in the hernial sac. The danger lies in a late diagnosis, due to neglect in the beginning, on account of the mild symptoms.

Treatment

Treatment is limited to dealing with the inflamed omentum. It should be freed from adhesions, ligated by small multiple ligatures and excised. Care must be taken not to ligate too close to the transverse colon, which may be hidden behind adherent masses of fat.

The omentum should be ligated obliquely; if cut off transversely, the stump is sometimes so thick it cannot be reduced. Simple irreducibility of

an omental hernia may be treated by rest, restricted diet, and continuous pressure on the tumor, as described for massive umbilical hernia.

Noninflamed omentum should always be returned to the abdominal cavity. The excision of omentum raises the mortality rate slightly on account of the danger of embolism, thrombosis, and postoperative epiploitis. For this reason omentum should always be treated conservatively.

POSTOPERATIVE EPIPLOITIS

Postoperative epiploitis occurs in an omental stump that has been returned to the abdominal cavity. The condition may develop any time from a few days to a year after operation, and it is sometimes due to too much fat being left distal to the ligature. This becomes infected and a mild localized epiploitis develops, which may clear up in a few days or go on to suppuration, accompanied by severe general and local symptoms of peritonitis. An abscess may form, and if not opened, it may break through into the intestine or open externally through the abdominal wall.

Some of the writers in the latter part of the 19th century believed that postoperative epiploitis was usually due to infected absorbable suture material. Granting that was the cause at that time, although it is improbable, our present day methods of sterilization of sutures, if properly carried out, destroy all germs, and there is no excuse for local infection of the omental stump from this source.

Symptoms

In postoperative epiploitis, the patient complains of pain in the abdomen, which is aggravated by moving in bed or attempting to get up. There are often no gastrointestinal symptoms. Sometimes a mass can be felt through the anterior abdominal wall that will give a clue to diagnosis. The tumor is usually hard and irregular in shape and the localized peritonitis may make palpation painful and difficult. Rectal or vaginal examination is sometimes of value.

Treatment

In simple plastic epiploitis, spontaneous cure is frequent, even when the tumor is large. Palliative measures consist of rest in bed and an ice bag placed over the mass.

In suppurative epiploitis the symptoms are severe and point to intra-abdominal suppuration. The pressure of the infected mass may cause intestinal obstruction. When there are definite symptoms of abscess formation, the abdomen should be opened over the suspected point, the abscess incised, the pus evacuated and drainage established. The operation should be carried out as gently as possible, avoiding trauma to the tissues, and the opening up of new avenues of infection in the peritoneum. Surgery in epiploitis

should be employed sparingly. When obstruction of the intestine is caused by epiploitis and the adhesions cannot be freed, it is sometimes necessary to do an anastomosis around the obstruction and resect the intestine between these points, together with the infected omentum.

VOLVULUS OF THE OMENTUM

Torsion or twisting of the omentum occasionally occurs as a complication of hernia. This condition was described by Oberst in 1882, and Demons in 1884, who also reported cases. Lucas-Championnière, in 1900, wrote at length on this subject. In 1903 Vignard and Giraudeau collected 20 cases in the literature. Corner and Pinches, in 1905, published an important paper proposing a simple classification of the varieties of torsion of the omentum. In the same year Roche found 29 cases in the literature, and in 1906 Pretzsch

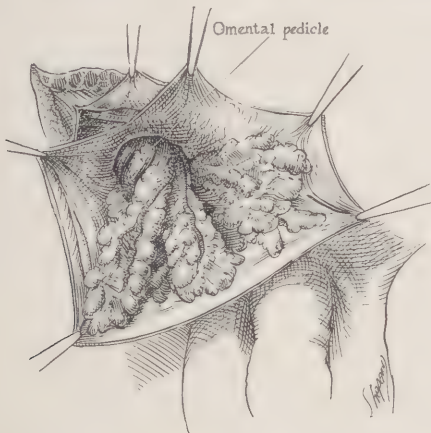


Fig. 19.—Volvulus of the omentum in a hernial sac.

was able to collect 66 cases. In 1906 Smythe also reported a case and called attention to the similarity of symptoms of torsion and appendicitis. Valuable papers were published by Lejars in 1907; Carnett in 1910; Patel and Santy, in 1913; Hartwell, in 1915, who reported a case in which the symptoms simulated gastric ulcer; and Bookman, in 1915, who was able to collect 131 cases in the literature.

Etiology

Torsion of the omentum nearly always occurs in inguinal hernias. Of 20 cases studied by Vignard and Giraudeau, 19 were inguinal. It usually complicates old hernias, both reducible and irreducible. Sometimes the only sac content is the portion of the omentum that has become adherent. (Fig. 19.)

Possible causes of torsion are taxis, pressure from a truss, and the continual movement of nonadherent omentum in the sac.

Varieties

There are two anatomic varieties of omental torsion, intrahernial and intraabdominal:

1. **Intrahernial Torsion.**—Intrahernial torsion is infrequent. The omentum is usually adherent above at the neck of the sac and below at the fundus or near it. The twisting takes place between these two points. (Fig. 19.) The sites of adhesion may be anywhere in the sac, or the omentum may be twisted on itself without adhesions, as in the case observed by Heitz and Bender. Chavannaz saw a true omental knot in a hernial sac.

2. **Intraabdominal Torsion.**—Intraabdominal torsion is the variety usually seen. The omental torsion takes place within the abdominal cavity, while the intrasaccular portion is adherent to the sac wall, or is free in rare cases. There may be one or more complete twists. Malherbe reported a case with three turns, and Block and Darmstadter saw one in which the gangrenous omentum had undergone five and one-half complete turns.

In rare instances intraabdominal and intrahernial torsion are found in the same patient. The twists are usually in opposite directions. The torsion of the intraabdominal omentum takes place near the insertion of the great omentum into the colon. The changes in the omentum depend on the degree of constriction, and range from a slight congestion to complete gangrene. Lucas-Championnière reported a case in which the mass was hard and inflamed, and was mistaken for a new growth. The omentum is always fixed at one point—its insertion into the colon. Usually it is also attached to the sac wall.

Symptoms

From a clinical standpoint, torsion of the omentum is also divided into two varieties, the intrahernial and intraabdominal:

1. **Intrahernial.**—In the intrahernial variety the mass is painful, tense, increased in size, and presents the symptoms of hernial epiploitis. The diagnosis is rarely made before operation, which is usually undertaken for suspected epiploitis.

2. **Intraabdominal.**—There are two types of intraabdominal torsion of the omentum, the acute and the chronic.

a. *Acute.*—In the acute type the onset is sudden, with pain referred to the lower part of the abdomen, often with nausea, vomiting and partial constipation. When there are also symptoms of epiploitis in the hernial sac, the abdominal symptoms are more severe than the local ones. In acute torsion of the omentum, the mass is usually found in one of the iliac fossae, and feels as though it is attached to the posterior surface of the abdominal wall. Sometimes the connection between the abdominal and hernial swelling can be established. The comparatively large tumor and the mild symptoms should make the examiner think of omental torsion. However, exploratory laparotomy is usually required to make a positive diagnosis.

b. *Chronic*.—In the chronic type the symptoms are subacute, often resembling intestinal obstruction, and for this reason a diagnosis based on the symptoms is rarely possible. Consequently the connection between the intra-abdominal condition and the hernia, when it is reducible, is seldom suspected before the operation.

Prognosis

The prognosis for torsion of the omentum is always serious on account of the danger of epiploitis, and the possibility of gangrene developing in the twisted omentum. Intestinal hemorrhage and ulceration due to thrombi in the vessels, sometimes develop as a result of omental torsion. Early operative intervention is always indicated when omental torsion is suspected.

Treatment

The hernial sac should be opened, the omentum exposed, examined, and untwisted, providing it is healthy and only slightly twisted. While a simple untwisting of the torsion is sometimes sufficient, there is always danger of the condition recurring, and a safer plan is to resect the omentum, taking care not to cut too close to the intestine. When the omentum is inflamed, extensively adherent or gangrenous, it should be resected by means of multiple ligations. When there are abdominal symptoms, it is usually necessary to make a second incision, opening the abdomen to deal with the intra-abdominal torsion; this is a better plan than cutting through the hernial ring to reach the abdomen, thereby increasing the chance for a recurrence of the hernia.

When the torsion is intrahernial, it is very important to make sure that there is no torsion higher up in the abdomen. Eiselsberg and Moresco reported cases of intrahernial torsion in which intraabdominal torsion also existed, and was overlooked at operation. The twisted omentum became gangrenous and caused the death of the patients.

Bibliography

HERNIA AND VOLVULUS OF THE OMENTUM

- BLOCK, F. B., AND DARMSTADTER, H. J.: Torsion of the omentum. *J. Am. M. Assn.*, Chi., 1920, lxxiv, 881-882.
- BOOKMAN, M. R.: Occult strangulated inguinal hernia; spontaneous reduction "en masse." *Ann. Surg.*, Phila., 1915, lxi, 730-734.
- CARNETT, J. B.: A case of intestinal obstruction due to volvulus through a traumatic mesentery rent. *Univ. Penn. M. Bull.*, Phila., 1909-10, xxii, 172-173.
- CHAVANNAZ, G.: Nœud épiploïque dans une hernie inguinale; hydrocèle enkystée du cordon et hydrocèle vaginale concomitants, intervention; guérison. *Gaz. hebdom. d. Sc. méd.*, de Bordeaux, 1900, xxi, 339-341.
- CORNER, E. M., AND PINCHES, H. I.: Torsion of the great omentum. *Am. J. M. Sc.*, Phila., 1905, n. s. cxxx, 314-329.
- DEMONS, A.: See Jaboulay, M. et Patel, M., p. 279.
- EISELSBERG, A. von: Ein Fall von Volvulus des netzes welcher mit frischen ulcera des Magens und Duodenums kombinirt war. *Deutsche med. Wehnschr.*, Leipz., 1898, xxiv, (Vereins-Beilage), 260-261.

- HARTWELL, J. A.: Torsion within the lesser omentum simulating subacute perforation of a gastric ulcer. *Ann. Surg., Phila.*, 1915, lxi, 626-627.
- HEITZ, M. J., AND BENDER, X.: Une variété nouvelle de torsion de l'épiploon. *Bull. et mém. Soc. anat. de Par.*, 1900, lxxv, 957-960.
- JABOULAY, M., AND PATEL, M.: Hernies. *In: Nouveau Traité de chirurgie*, xxv, Le Dentu, A., and Delbet, P., Paris, Baillière, 1908.
- LEJARS, F.: Les torsions du grand épiploon. *Semaine méd., Par.*, 1907, xxvii, 73-77.
- LUCAS-CHAMPIONNIÈRE, J.: Epiploïte spéciale constituant une volumineuse tumeur au-dessus d'une hernie inguinale. Lésions de torsion rappelant celles des kystes de l'ovaire. *Bull. et mém. Soc. de chir. de Par.*, 1900, xxvi, 525-531.
- MALHERBE, A.: See Jaboulay, M. et Patel, M.: p. 281.
- MORESCO, G.: Sopra un caso di torsione dell' epiploon. *Gaz. d. osp., Milano*, 1902, xxiii, 693-695.
- OBERST, M.: Zur Kasuistik des Bruchschnittes nebst einigen Bemerkung über Netzeinklemmungen. *Centralbl. f. Chir., Leipz.*, 1882, ix, 441-447.
- PATEL, M., AND SANTY, P.: Un cas de torsion intraherniaire du grand épiploon. *Lyon chirug.*, 1913, x, 35-37.
- PIPELET, LE JEUNE: Sur les signes illusoirs des hernies épiploïques. *Mém. Acad. roy. de chir., Par.*, 1774, xv, 84-96.
- PRETZSCH, E.: Ueber die Torsion des Netzes. *Beitr. f. klin. Chir., Tübing.*, 1906, xlviii, 118-140.
- ROCHE, G.: Des torsions de l'épiploon. Thèse, Paris, 1905.
- SMYTHE, F. D.: Report of a case of torsion of the greater omentum, intra-abdominal, with remarks. *Surg. Gynec. & Obst., Chi.*, 1906, iii, 531-533.
- VIGNARD, E., AND GIRAudeau: Torsion intra-abdominale du grand épiploon. *Arch. prov. de chir., Par.*, 1903, xii, 206-230.

CHAPTER VI

FATTY HERNIA

Synonyms.—Prehernal lipoma; Hernia adiposa; Liparocoele; Steatocoele.

Definition.—A fatty hernia is a mass of fat not enclosed by a peritoneal sac, situated at a hernial opening.

I believe that these lipomas should be called hernias only when they are accompanied by a peritoneal sac. Most so-called fatty hernias are simply isolated masses of fat, unattached to a sac. True fatty hernias are most frequently encountered in the linea alba, and in femoral hernias in women. They are seldom found in the umbilical or inguinal regions. Strangulation is very rare.

Historical

One of the earliest references to fatty hernia was made by Paré, who discovered a case at autopsy and described it in 1579. Strangulated fatty hernia was mentioned by Tartra, Bigot, and Cruveilhier, but the subject received little attention until Delaunay, in 1861, collected 40 cases from the literature. Wernher, in 1869, wrote an excellent historical review of fatty hernia. Important papers have been published by Caubet, Kauffmann, Wendel, Cooper, Sachs, Annandale, and Hardouin who collected from the literature the cases of strangulated fatty hernia; and Ransohoff, Friedman, Hale, and Tourneux who reported cases of strangulated fatty hernia.

Anatomy

a. **Simple Fatty Hernia.**—The lipomatous mass of simple fatty hernia differs very little from other subcutaneous fat. On account of its exposed position, a fatty hernia is often subject to inflammatory changes, resulting in the formation of a hard mass, irregular in outline. Fatty hernias are sometimes painful. (This point is fully discussed in the chapter on hernia in the linea alba.)

b. **Strangulated Fatty Hernia.**—Examination of a strangulated fatty hernia, after it is excised, shows recent or old areas of thrombosis or hemorrhage. The mass may show a beginning inflammation, or an abscess may already have formed. Gangrene due to strangulation at the neck of the lipoma or to torsion does occur, but it is very rare. In strangulated fatty femoral hernia the femoral ring is nearly always the point of constriction.

Etiology

Fatty hernias are most often seen in young persons, but strangulation is more frequent in middle life, between 40 to 45 years of age. The peritoneal diverticulum that accompanies a true fatty hernia is usually rigid and inelastic,

consequently it cannot hold a hernia and the examining finger enters the diverticulum with difficulty.

Wendel found a complete torsion of a lipoma with an open peritoneal diverticulum.

Strangulation.—Strangulation is most frequent in females. Of 15 cases collected by Tourneux, 11 were in females, and 4 in males. It was usually on the right side; this side being affected in 9 subjects, the left side in 3 subjects, and in 3 the side was not designated.

Mechanism of Strangulation.—In the beginning of strangulation there is usually only a part of the lipoma beneath the skin in the subcutaneous tissues, and gradually more fat is forced through the hernial orifice by increased intra-abdominal tension or a sudden strain. When the peritoneal diverticulum attempts to pull back the intraabdominal fat, the mass is caught in the ring; it may become twisted, its blood supply obstructed, or it may rarely become strangulated.

The mass is seldom larger than a pigeon's egg, and with the onset of gangrene, it turns reddish-brown in color, and has a consistency similar to that of molasses.

Symptoms

Simple lipomas are ordinarily painless and cause no symptoms except the slight discomfort from their presence. When a fatty hernia makes traction on a peritoneal sac, it may produce pain and reflex symptoms which necessitate operative relief. This often happens when the hernia is in the linea alba. Pain is not so uniformly present in the other varieties.

Symptoms of Strangulation.—There is generally a history of a fatty tumor having been present for some time before symptoms of strangulation develop. It is exceptional for strangulation to occur with the first appearance of the tumor. However, such cases have been recorded by Sachs, Wendel, and Aronheim. In Wendel's case, the lipoma had made two complete turns on its pedicle.

The pain is most marked over the lipoma. The congestion and inflammation in the tumor are responsible for the general symptoms, such as nausea, vomiting, abdominal distention, partial constipation or obstruction. However, these symptoms are not always present. In some cases the symptoms do not develop for some time after the appearance of the mass; in others, the symptoms are of sudden onset due to torsion or strangulation of the lipoma.

When the lipoma is strangulated it is hard, painful and irreducible and difficult to differentiate from a small strangulated enterocele or omentocele.

In acute strangulation the symptoms develop slowly, usually in from four to six hours, and the typical symptoms are not well defined until about twenty-four hours later.

Diagnosis

Diagnosis is most difficult when the tumor appears suddenly after a strain, with pain, more or less nausea, vomiting, abdominal tenderness, and meteorism.

Differential Diagnosis.—Inflamed or strangulated fatty hernia must be distinguished from reducible, irreducible, and strangulated hernia of the intestine, omentum, or other abdominal viscera. Also from hernial peritonitis, strangulated partial enterocele, hernia of the vermiform appendix, hernia of an epiploic appendix or Meckel's diverticulum, volvulus of the omentum or intestine, strangulation of an internal hernia, intestinal obstruction, ectopia testis, epididymitis, orchitis, and adenitis.

FATTY HERNIA	ORDINARY HERNIA
Appears without apparent cause or history of strain	Congenital or following a strain
Does not change in size and is irreducible	Changes in size and is usually reducible
No impulse on coughing	Impulse on coughing
Slowly increases in size	May increase rapidly in size

Treatment

Small fatty hernias without symptoms usually do not require treatment. When there is pain or reflex symptoms, operative treatment may be demanded (see chapter on hernia in the linea alba). Large fatty hernias without symptoms may require operation on account of the physical inconvenience they cause, or as a preventive measure against the subsequent development of an enterocele or omentocele.

Before excising the fatty mass the operator must be sure that it consists only of adipose tissue. Injury to the intestine and omentum must be guarded against, and in the femoral and inguinal regions, the bladder, appendix, ureter, and a Meckel's diverticulum must be thought of. When the peritoneal cavity is opened while dissecting out and excising the lipoma, the peritoneal edges should be sutured together and the hernial opening closed in the manner described in the chapters on the special hernias.

Bibliography

FATTY HERNIA .

- ANNANDALE, T.: On fatty hernia. *Edinb. M. J.*, 1869-70, xv, 769-777.
- ARONHEIM: Ein Fall von plötzlich auftretendem und Ileus verursachendem Fettbruch des Leistenkanals bei einer 83 jährigen Frau. *Monatschr. f. Unfallheilk.*, Leipz., 1905, xii, 190-193.
- BIGOT, T. C.: Dissertation sur les tumeurs graisseuses extérieures au péritoine qui peuvent quelquefois simuler des hernies. Thèse, Paris, 1821.
- CAUBET, H.: Des hernies inguinales graisseuses. *Presse méd.*, Par., 1903, xi, 37-40.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key. London, Longman, Rees, Orme, Brown & Green, 1827.
- CRUVEILHIER, J.: *Traité d'anatomie pathologique générale*. Paris, Baillière, 1849, i, 634.
- DELAUNAY, A.: Relevé des observations des hernies étranglées. *Gaz. méd. de Par.*, 1861 3.s., xvi, 205, 251, 268.
- FRIEDMAN, L.: Hernia adiposa. *Ann. Surg., Phila.*, 1913, lvii, 204-209.

- HALE, K.: Fatty hernias. *Ann. Surg., Phila.*, 1919, lxi, 278-285.
- HARDOÛIN, P.: Des symptômes d'étranglement causés par les lipomes préherniaires de la région inguino-crurale. *Arch. gén. de chir., Par.*, 1912, viii, 497-511.
- KAUFFMANN, E.: Ueber plötzliches Auftreten und Einklemmung von Fettbrüchen. I. D., Freiburg, 1904.
- PARÉ, A.: Oeuvres. Paris, G. Buon, 1579, 299-300.
- RANSOHOFF, J.: Fat hernia. *Lancet-Clinic, Cincin.*, 1913, cix, 6-10.
- SACHS, W.: Ueber Einklemmungserscheinungen bei Fettbrüchen. München, med. Wehnschr., 1908, lv, 2227-2230.
- TARTRA: See Sachs, W.: p. 2227.
- TOURNEUX, J. P.: Les lipomes préherniaires étranglés. *Rev. de chir., Par.*, 1920, lviii, 653-668.
- WENDEL, W.: Ueber die Torsion eines "Fettbrüches" und ihre Folgen. *Deutsche Ztschr. f. Chir., Leipz.*, 1902, lxv, 388-392.
- WERNHER, A.: Von den Fettbrüchen und den bruchähnlichen Fettgeschwülsten. *Arch. f. path. Anat. [etc.]*, Berl., 1869, xlvii, 178-214.

CHAPTER VII

LOCAL ANESTHESIA IN HERNIA OPERATIONS

Local anesthesia is being used more and more for hernia operations. While in certain cases general anesthesia is sometimes necessary, a study of statistics of complicated or strangulated hernias shows that ether anesthesia leaves much to be desired.

Indications for Local Anesthesia.—In selecting the anesthetic for a hernia operation, the life of the patient is always the first consideration, a fact that is sometimes lost sight of by those who condemn the local method, because it takes too much time. While anesthesia by the infiltration method usually requires more time than general anesthesia, this is not true of the regional method. With regional anesthesia the field of operation can be completely blocked in less time than it takes to secure surgical analgesia with general anesthesia. Reclus remarked that the operation for hernia is the triumph of local anesthesia.

It is indicated for nonstrangulated and strangulated inguinal and femoral hernias, and for a majority of the umbilical and ventral varieties.

Local anesthesia adds greatly to the comfort and safety of the young and robust, and when the patient is handicapped by old age, shock, hemorrhage, pulmonic, nephritic or cardiac lesions, the local method is especially indicated, if he is to be given the greatest chance for recovery. Local anesthesia removes the danger from ether pneumonia and renal insufficiency. I recall the case of a young man, 25 years old, who developed anuria following an ether anesthesia for a small inguinal bubonocoele. The operation lasted only one-half hour. The first twenty-four hours he passed three ounces of bloody urine, one ounce the second day, and he died on the third day.

Advantages of Local Anesthesia.—Every step in the operation that is carried out under general narcosis can be done with local anesthesia. In strangulation, with the accompanying lowered vitality, local anesthesia is a safeguard against shock, and it also provides ample time to determine the viability of the intestine, and if resection is necessary, it can be done without additional risk to the patient.

Extreme old age, organic disease of the cardiovascular system, lungs or kidneys, were formerly believed to be contraindications to the radical operation for nonstrangulated hernia. With a good technic, there is practically no contraindication to the cure of every hernia, regardless of the age of the patient. Some of my most grateful patients have been subjects over 70 years of age. (Fig. 20.)

Contraindications.—To my mind there is only one contraindication to the use of local anesthesia in nonstrangulated hernia, and that is the case of the

patient who does not want it, who for any reason prefers to be asleep during the operation. It is often a mistake to urge local anesthesia on the skeptical, and as a rule, I administer a general anesthetic to this type of patient, provided, of course, that he is in every way a suitable risk for it.

Local anesthesia is usually contraindicated in children and neurotic subjects when the hernia is not strangulated. However, there are exceptions to this rule: I recall the case of a boy, five years old, with a right inguinal hernia, whose parents insisted on local anesthesia because another member of the family had recently succumbed to an ether anesthetic for a simple hernia operation. The little patient did not complain of pain at any time, although it was hard to keep him still, as he insisted on getting down on the floor and playing with

Hour	Pulse				Systolic Blood Pressure				
	40	50	60	70	100	110	120	130	
9:35	■	■	■		■	■	■		BEFORE OPERATION
40	■	■	■		■	■	■		NERVE BLOCK OF SKIN AND SUBCUTANEOUS TISSUES
43	■	■	■		■	■	■		INCISION MADE
50	■	■	■		■	■	■		ILIOINGUINAL AND ILIOHYPOGASTRIC NERVES BLOCKED
52	■	■	■		■	■	■		SAC EXPOSED AND FREED UP TO INTERNAL RING
55	■	■	■		■	■	■		SAC OPENED AND ADHERENT OMENTUM FREED
58	■	■	■		■	■	■		NECK OF SAC BLOCKED
10:00	■	■	■		■	■	■		SAC LIGATED AND EXCISED
05	■	■	■		■	■	■		DEEP SUTURES PLACED
10	■	■	■		■	■	■		APONEUROSIS SUTURED
15	■	■	■		■	■	■		SUBCUTANEOUS TISSUES AND SKIN SUTURED
25	■	■	■		■	■	■		OPERATION COMPLETED

Fig. 20.—Pulse and systolic blood pressure chart. Inguinal hernia operation under local anesthesia. No morphine. Mr. D. (case B865), aged 30. Throughout the operation there was little change in the pulse or systolic blood pressure.

his toys. Lee has reported a successful operation for strangulated hernia under local anesthesia in an infant, 20 days old.

Anesthetic Agents. 1. *Cocain*.—Cocain hydrochlorate was the first drug used to produce local anesthesia. It gives an immediate and longer anesthesia than the safer substitutes, but it is too dangerous for general use. Cocain is not only very toxic, but many patients have an idiosyncrasy for it, and for this reason it should not be employed in hernia operations. However, if no other anesthetic is available for an emergency operation, cocain can be used in a 0.1 per cent solution to which epinephrin (adrenalin, suprarenin) has been added. 2 minims of epinephrin solution (1:1,000) to each ounce (30 c.c. or mils) of the

anesthetic solution. Not more than 4 ounces (120 c.c. or mls) of this solution should be used in the course of an hour, and not more than one ounce (30 c.c. or mls) should be injected in a 15 minute period. The margin of safety is greatly increased by using a 0.1 per cent solution. Four times as much cocain in a 0.1 per cent solution can be injected with safety, as when a 1 per cent solution is used.

2. *Novocain*.—Novocain or procain is the most generally used local anesthetic. It is about one-seventh as toxic as cocain, and a relatively large amount of a 0.2 per cent solution can be injected without danger of toxic symptoms. One-half per cent solution is used for the skin and nerve trunks and 0.2 per cent solution, elsewhere. It is necessary to add 2 minims (0.12 c.c. or mls) of epinephrin solution (1:1,000) to each ounce (30 c.c. or mls) of the novocain solution. The novocain must be sterile, and dissolved in sterile normal salt solution or Ringer's solution. The anesthetic solution must be freshly prepared for each operation, and always of a definite strength so that the operator may know at any time the exact amount of drug that has been used.

3. *Apothesin*.—Apothesin is of low toxicity, nonirritating to the tissues, and its anesthetic action is similar to that of novocain. It is used in the same strengths as novocain, and is prepared in the same manner. Apothesin is precipitated by alkalies, and syringes and needles that have been boiled in an alkaline solution should be rinsed out with plain sterile water before using.

4. *Butyn*.—Butyn is one of the best of the local anesthetics, and is especially adapted to hernia operations because the anesthesia appears immediately after the solution is injected—quite an important point for the busy surgeon. Butyn is about one-third as toxic as cocain and is non-irritating to the tissues. It should be dissolved in sterile water, 2 minims (0.12 c.c. or mil) of epinephrin added, and then boiled for two minutes. This boiling causes a slight cloudiness that disappears after the solution has stood a while. One-fifth per cent solution is sufficient for hernia operations, and the anesthesia will last for an hour or an hour and a half.

5. *Eucaïn*.—a. Eucaïn B.—Beta-eucaïn hydrochlorid was a popular local anesthetic before the discovery of novocain. It is slightly irritating to the tissues, and two or three times less toxic than cocain. Beta-eucaïn should always be combined with epinephrin (adrenalin, suprarenin) as it produces vasodilatation of the capillaries when used alone, thus predisposing to postoperative hemorrhage.

b. Eucaïn lactate.—Eucaïn lactate is a more recent preparation of eucaïn. It is similar to beta-eucaïn in toxicity but is much less irritating to the tissues, and is to be preferred when eucaïn is used. Eucaïn is employed as a local anesthetic in 0.2 to 0.5 per cent solution.

6. *Quinin and Urea Hydrochlorid*.—Quinin and urea hydrochlorid solution is not suitable for local anesthesia in hernia operations because necrosis of the skin and subcutaneous tissues sometimes follows its use. Even when a weak

solution (0.25 per cent) is used, a fibrinous exudate forms in the wound and healing is slightly delayed. In isolated cases, it may be advisable to inject a 0.2 per cent solution at a distance from the edges of the wound to prevent postoperative pain.

Preparation of the Anesthetic Solution.—The anesthetic solutions should be freshly prepared for each operation, and distilled water should always be used in making them. Harris has pointed out that ordinary tap water often contains anerobic spore-forming organisms which may not be killed by a single boiling, and the use of this non-sterile solution may cause infection of the wound.

A simple plan is to dissolve the anesthetic substance in a small amount of distilled water in a test tube, boil for three minutes and then add the solution to the proper amount of distilled water, sterile normal salt solution or Ringer's solution. To prepare a 0.1 per cent solution, dissolve 1 grain (0.065 gm.) in 2 ounces (60 c.c. or mls) of solution; for a 0.2 per cent solution add 1 grain to 1 ounce (30 c.c. or mls), and to make a 1 per cent solution dissolve 5 grains (0.265 gm.) in one ounce (30 c.c. or mls) of solution.

To Prolong the Anesthesia.—The ordinary anesthetics do not give an analgesia that lasts long enough for the average hernia operation, and it is necessary to add a substance to prolong the anesthesia period. I usually use calcium chlorid for this purpose as there is no danger of its causing necrosis in the wound, as epinephrin sometimes does if it is used in too concentrated solution, especially in aged patients or in the obese.

1. *Epinephrin.*—Epinephrin (adrenalin, suprarenin), is added in the proportion of 2 minims (0.12 c.c. or mil) to each ounce (30 c.c. or mls) of the anesthetic solution, so that the analgesia, instead of lasting only 5 to 20 minutes, will persist for 30 to 60 minutes, depending on the anesthetic selected and the strength of the solution, and there is ample time to complete the ordinary hernia operation before sensation returns.

Other drugs that are sometimes used in conjunction with epinephrin to prolong anesthesia are chlorobutanol, potassium sulphate and calcium chlorid.

2. *Chlorobutanol.*—Chlorobutanol is soluble in water, 8 parts in 1,000. It intensifies the anesthesia and is an excellent antiseptic when it is necessary to prepare the solution some time before it is to be used. Chlorobutanol is decomposed by boiling, therefore, it should not be added until the solution has cooled.

3. *Potassium sulphate.*—Potassium sulphate 0.25 per cent solution is valuable to intensify and prolong the anesthesia. Hoffmann and Kochmann stated that it increases the anesthetic effect 100 per cent.

4. *Calcium chlorid.*—Calcium chlorid also intensifies the anesthesia. It is used in 0.25 per cent solution. Harris advocated adding both potassium sulphate (0.25 per cent) and calcium chlorid (0.25 per cent) to the novocain or apothecin solution, and finally adding the epinephrin. For additional information regarding the chemical and physiological properties of the various local

anesthetics, consult the special works on local anesthesia by Allen, Smith, Braun, Sherwood-Dunn, Hertzler, Reelus, Pauchet, Labat, Farr, and others.

Toxicity of Local Anesthetics.—All local anesthetics are toxic, if a sufficient amount is injected. Several factors govern the toxicity, namely, the age and general health of the patient, his personal idiosyncrasy, the concentration of the solution, the rapidity of the injection, and the kind of tissue injected. The more vascular the tissue the quicker the absorption. Accidental injection into a blood vessel may result fatally. This accident should never occur if the following precautions are observed: The operator should always know the exact location of the point of the needle; only a small amount of the solution should be injected at one time; the injection should be made slowly, and the needle kept moving while infiltrating the tissues.

Syringes and Needles.—1. *Syringe.*—Different operators prefer various syringes. In an emergency, the ordinary 30 minim (2 c.c. or mls) pocket hypodermic syringe can be used. A 5 to 20 c.c. or mls syringe is the best, as it saves the time required for the frequent refilling of a smaller syringe. The syringe may be of glass or metal. (Fig. 21.)

I prefer an all-metal syringe. The one made for me by Becton, Dickinson

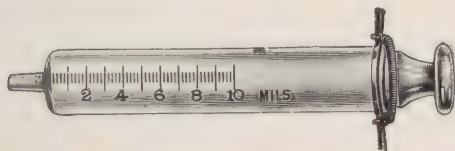


Fig. 21.—A 10 c.c., or mls, glass hypodermic syringe.

Co. has been designed especially for local anesthesia work in general surgery that requires intradermal infiltration of the skin under pressure.

The syringe is unbreakable, it will last for years and the cost is about the same as for a glass syringe. It is made of light metal, has comfortable ring finger-rests, and holds $\frac{1}{4}$ ounce (7.5 c.c. or mls). The eccentric tip permits the needle to lie parallel with the skin, making intradermal infiltration easy.

The syringe is equipped with the Luer needle-lock features, and it is impossible for the needle to fly off even under the strongest pressure. The needle is securely fastened by turning to the right and is easily removed by turning to the left. A metal disk near the hub prevents the needle from slipping into the tissues in case it breaks. The ordinary Luer slip-needle can also be used with this syringe.

With simple care the piston will fit tight and never stick. The barrel and piston should always be sterilized separately, and never put together until they have cooled off. The piston should be lubricated with a drop or two of mineral oil before the syringe is put away. (Fig. 22.)

The syringe should take a slip-needle (Luer or Record) to facilitate rapid refilling. The infiltration of the skin and nerve sheaths is easy if the syringe has an eccentric tip, so that the needle is on a line with the lower part of the body of the syringe.

2. *Needles.*—The needles should be of small caliber, from 1 to 2 inches (2.5 to 5 cm.) in length, and should always be kept sharp and clean. A longer needle is seldom required, except for blocking the deep nerves before incising the skin as required in the regional method for the inguinal hernia operation. The finest needle should always be selected for the initial skin wheal.

Technic of the Injection.—The anesthetic solution should be freshly prepared and is least irritating when it is injected at body temperature. The physician who would use local anesthesia should remember that the successful operation is painless. Patients frequently fall asleep during the latter part of a tedious hernia operation, especially after the peritoneum has been closed.

Success depends upon patience, an intimate knowledge of the sensory nerve distribution, and special training in the method. The technic of the injection is always delicate; it varies in each patient, in each operation and in each region. The rapidity, intensity and duration of anesthesia depend on the anes-

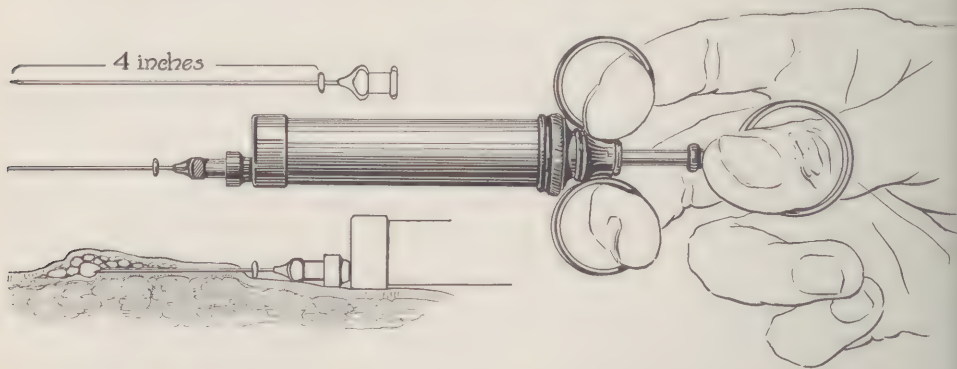


Fig. 22.—The author's all-metal hypodermic syringe for local anesthesia. The syringe holds $\frac{1}{4}$ ounce (7.5 c.c. or mls). It has comfortable ring finger-rests, an eccentric tip to facilitate skin infiltration, and the Luer needle-lock to prevent the needle from flying off when injecting the anesthetic solution under pressure. The ordinary Luer slip-needle can also be used.

thetic and the strength of the solution. The surgeon must not begin the operation until anesthesia is complete, usually five to ten minutes after injection. He must always be careful to keep well within the zone of anesthesia. Beginning the operation before anesthesia is complete, and carelessly cutting into unanesthetized tissues will quickly destroy the patient's confidence, and once it is lost, it cannot easily be regained. The patient should be told that the anesthetized area will feel numb, and while he can hear the moving of the instruments and feel some pulling of the tissues, there will be no pain.

As Smith has remarked, there is no legerdemain in local anesthesia; it is simply a question of mastering the technic. When the patient becomes restless and complains of a vague general pain in the wound during a tedious operation, it usually means that skin sensation is returning. It is a simple matter to re-inject the skin wound, and the patient is soon comfortable again.

In blocking the ilioinguinal and iliohypogastric nerves, the anesthetic is injected into the nerve sheath, and not directly into the nerve itself. (The detailed technic of the infiltration is fully described step by step in the chapter on the operation for inguinal hernia. In general, this method is applicable to hernias in other regions, and the variations in technic for other varieties are considered in discussing the treatment of these special hernias.)

Preoperative Treatment.—When indicated, young and middle-aged patients with nonstrangulated hernia receive a dose of morphin sulphate (from one-sixteenth to one-fourth grain, 0.004 to 0.0162 gm.) one hour before operation to allay any restlessness or nervousness. The administration of an intestinal antiseptic before operation is helpful in preventing postoperative gas pains. (The general preoperative treatment has already been described elsewhere.)

Delayed Wound Healing.—Sloughing after local anesthesia is due to too extensive edematization of the tissues, the use of nonsterile or nonisotonic solutions, or to too much epinephrin in the anesthetic solution. When sloughing occurs, it is nearly always in aged patients in whom the tissues are of low vitality. In these subjects the anesthetic solution should be injected carefully, so that every drop counts, and if just enough is used to secure anesthesia, and unnecessary infiltration of distant tissues avoided, there will be no sloughing. In several hundred hernia operations under local anesthesia, I have never seen sloughing of the wound. Delayed wound healing is common after the use of quinin and urea as the local anesthetic.

Bibliography

LOCAL ANESTHESIA

- ALLEN, C. W.: Local and regional anesthesia. Phila., W. B. Saunders Co., 1918.
- BRAUN, H.: Die Lokalanästhesie, ihre wissenschaftlichen Grundlagen und praktische Anwendung. Leipzig, J. A. Barth, 1913.
- FARR, R. E.: Practical local anesthesia, Philadelphia, Lea & Febiger, 1923.
- HARRIS, M. L.: Local anesthesia. *In*: Oxford Surgery. New York, Oxford University Press, 1920, i, 97-135.
- HARRIS, M. L.: Local anesthesia. *In*: Keen's Surgery. Phila., W. B. Saunders Co., 1921, viii, 847-859.
- HERTZLER, A. E.: Surgical operations with local anesthesia. New York, Surgical Publishing Co., 1916.
- HOFFMANN, A., AND KOCHMANN, M.: Verminderung der Novokainkonzentration durch Kaliumsulfat bei der Lokalanästhesie. Deutsche med. Wchnschr., Leipz., 1912, xxxviii, 2264-2267.
- LABAT, G.: Regional anesthesia. Phila., W. B. Saunders Co., 1922.
- LEE, W. E.: Radical cure of an incarcerated inguinal hernia in an infant twenty days old. Ann. Surg., Phila., 1914, lix, 440.
- PAUCHET, V., SOURDAT, P., AND LABOURE, J.: L'Anesthésie régionale. Paris, O. Doin et Fils, 1917.
- RECLUS, P.: L'anesthésie localisée par la cocaïne. Paris, Masson, 1903.
- SHERWOOD-DUNN, R.: Regional anesthesia. Phila., F. A. Davis Co., 1920.
- SMITH, A. E.: Block anesthesia. St. Louis, C. V. Mosby Co., 1920.

CHAPTER VIII

INGUINAL HERNIA

Synonyms.—Oblique inguinal hernia; Indirect or external hernia; Intra-inguinal hernia; Breach.

Direct inguinal hernia; Internal inguinal hernia; Straight hernia; Retro-inguinal hernia; *Hernie juxtafuniculaire*.

Definition.—Inguinal hernia is a protrusion of abdominal viscera through the anterior abdominal wall in the inguinal region.

HISTORICAL

The literature on the history of the treatment of inguinal hernia is so extensive that only the important points can be taken up here. (For further information regarding the traditions and methods, the historical introduction and references will be found to contain much that is interesting.)

Inguinal hernia is probably as old as the history of man. Among the ancient records, a Phœnician statuette of about 900 B.C., found by Poncet, shows a double inguinal hernia treated by a bandage. Hippocrates, in the 4th century B.C. wrote on hernia, and it is referred to in Leviticus, XXI, 17-20. For many centuries those afflicted with hernia were objects of scorn, ridicule and contempt. When strangulation occurred, if palliative measures failed, the patient was usually doomed to die unless relieved by the formation of an abscess or fecal fistula, as the ancients did not operate on strangulated hernia. The Roman physician, Celsus, who lived in the first century, was the first to operate for hernia, and his efforts were confined to the nonstrangulated variety. He made an incision over the hernia, loosened the sac and probably ligated and removed it; he thought it was both unnecessary and dangerous to open it. He usually tied the cord and removed the testicle, excised the redundant scrotum, and brought the edges of the wound together. In large hernias he cauterized the parts with caustics or a hot iron. Celsus speaks of practitioners who placed the empty sac between two pieces of wood, and applied pressure until gangrene developed. It was many centuries before operation was attempted in the strangulated variety, partly because of the agonizing torture of the ordeal, and few survived the attendant infection, peritonitis, hemorrhage and tetanus. Celsus' theory, that the site of constriction in strangulation was inside the sac prevailed until the 19th century, when Petit proved that it was outside of the sac.

Heliodorus in the 2nd century modified Celsus' operation. He retracted

the wound with hooks, held the testicle aside, and divided the tissues down to the peritoneum, separated the sac from the cord, replaced the testicle in the scrotum, and after inspecting the sac to make sure that no intestine had slipped down, he twisted the sac and cut it off. If intestine was adherent to the sac, the latter was excised around the adherent part. Oribasius, a Roman physician of the 4th century, freed the sac and twisted it, ligated it at the edge of the wound and excised the dependent part. In complicated cases he made a counter-opening in the scrotum, apparently for drainage. He believed that an active inflammation of the wound was followed by the best results.

Paulus Ægineta, in the 7th century, used a different operation for bubonocoeles than he employed in scrotal hernias or enterocoeles, as they were then called. For bubonocoeles he made a transverse incision about three inches (7.5 cm.) long over the hernia down to the sac, which was pressed upward into the inguinal canal with a probe, while the portions of sac bulging on each side of the probe were sutured together. He also advocated cauterizing a triangular area over the site of the hernia down to the subcutaneous fat. In scrotal hernia, he made a transverse incision in the scrotum large enough to permit the testis to be drawn out. He did not attempt to separate the sac from the cord. After transfixing and ligating the sac close to the incision, it was cut into four pieces, overlapped in the form of an X and twisted. The spermatic cord was usually ligated and cut away with the testis. He also pointed out the indications for dividing the constriction in the neck of the sac in strangulated hernia. The Arabian physicians, Albucasis, Avicenna, Rhazes, and Haly Abbas, followed the teachings of Paulus Ægineta, and were partial to cauterization of the parts with a hot iron. However, the actual cautery was gradually replaced by caustics, arsenic being the most used.

Guy de Chauliac, a French surgeon of the 14th century, divided hernias into two classes, inguinal and umbilical, and claimed to cure many of both varieties by bandages and plasters. The operation for strangulated hernia was first performed by Maupasius in 1559 and reported by Roussetus. Pierre Franco, who lived in the 16th century, devised the best operation for strangulated hernia up to that time. After exposing and reducing the hernia and cutting off the sac, the hemorrhage was checked, the edges of the wound retracted and caustics applied to stimulate the formation of scar tissue. Fabricius von Hilden described the treatment of strangulated hernia in 1610. Paré, in the 16th century, advocated massage treatment of hernia for young patients; he operated on older patients by reducing the hernia, passing a strong suture between the cord and the sac and tying over it an ivory plate, which was left in place ten to twelve days. Scultetus, in 1655, reduced the hernia, replaced the testis in the scrotum and held it in place by a suture in the inguinal canal. Dionis advised the use of drainage in hernia wounds,

the dilatation of the constricting ring to favor reduction, and the excision of omentum.

In the 18th century castration was so frequently performed during hernia operations that official edicts were issued in many countries forbidding the removal of the testis.

Albert classified the methods of treatment for hernia that were employed during the Middle Ages into five groups:

1. Castration.
2. Exposing the sac and treating it by one of the following procedures:
 - a. Double ligature and transverse division (William of Salicet, Guido, Rogerius, Jamerius, and the Four Masters).
 - b. Simple ligature of the sac.
 - c. Suture of the sac with a gold thread, the *punctum aureum*; the suture was often made of iron or lead (Geraldus), or silk (Pott).
 - d. Loose ligature of the sac, which is retracted to one side while the pubes are cauterized (Lanfranc, Petrus de Dya).
3. Inclusion of the sac and scrotum by means of needles (Lanfranc), or by a thread passed through the sac and tied over a piece of wood (Roger, Benedictus).
4. Actual cauterization of the skin and subcutaneous tissues down to the pubes.
5. Chemical cauterization (Theodoric, John de Crepatis, Andreas, Petrus de Orliato, Guido).

By the middle of the 18th century, operations for strangulated hernia were advocated by Petit, de Garengot, Le Dran, Richter, Heister, and others. De Garengot dissected out the sac, folded it into a pad, and sutured it in the inguinal canal. Saviard stated that few survived the ordeal of the operation. Bordenave wrote an excellent historical review of the treatment of hernia with caustics, and warned against their use. Camper described the methods of measuring for a truss much as it is done at the present time.

The operation for nonstrangulated hernia by incision of the sac was followed by such a high mortality that all operative treatment had been generally abandoned at the beginning of the 19th century by such eminent surgeons as Cooper, Pott, Scarpa, Boyer, and others. This condition of affairs stimulated the truss industry, and the mechanical treatment of reducible hernia flourished.

Lagenbeck, in the first half of the 19th century, was one of the few surgeons who had the courage to remove the sac. As late as 1838, Lawrence pointed out the serious complications that followed interference with it. Gerdy, writing in 1836, applied ammonia to the scrotum, which was then invaginated into the inguinal canal and retained by a suture. In 1836 Bonnet reduced the hernia, punctured the sac with needles which were removed and pressure applied, while suppuration was depended on to obliterate the sac.

Pancoast, in 1844, injected tincture of iodine into the sac. Velpeau opened the sac and applied the iodine direct. Many other injection methods have been described. In 1840 Wutzer invaginated the scrotum with a needle attached to a handle, and allowed this instrument to remain in place for a week to 10 days, hoping that sufficient scar tissue would form in the inguinal canal to effect a cure. The seton treatment is a similar method that was used by the ancients and advocated as late as 1870 by Holthouse, and consists of a silk or wire suture passed through the hernial sac and left in place until it cuts its way out. The localized peritonitis is supposed to obliterate the sac.

In 1857 Wood described his subcutaneous operation. Through a short skin and fascia incision he introduced a finger and invaginated the sac as high as possible into the inguinal canal. He then passed a suture to unite the internal oblique and conjoint tendon to Poupart's ligament. Similar operations were devised by Agnew, Dowell, Spanton, and others.

Bryant, in 1861, stated that the mortality of strangulated hernia was 22 per cent when the sac was not opened and 60 per cent when it was opened. McGill in 1883, and Rabagliati in 1884, found that the mortality rate was lower when the sac was excised than when it was left in situ.

Antiseptic surgery, introduced by Lister, ushered in a new era in the treatment of hernia. During the period between 1870 and 1890, the methods were revolutionized, and the open operations displaced the blind and uncertain procedures of the past, with the result that more progress was made in these twenty years than in all the centuries that had gone before. (For further information on the history of hernia and its treatment, consult the works of Albert, Manley, Macready, Marey, Wernher, Schmidt, Lowe, Lawrence, Velpeau, Berger, Malgaigne, and Wright).

Bibliography

INGUINAL HERNIA—HISTORICAL

- AGNEW, D. H.: Radical cure of hernia. *Med. & Surg. Reporter*, Phila., 1864-1865, xii, 461-463.
- ALBERT, E.: *Die Herniologie der Alten*, Beiträge z. Geschichte der Chirurgie. Wien, 1878.
- ALBUCASIS: See Paulus Ægineta, p. 375-376.
- AVICENNA: *Liber canonis, de medicinis cordialibus, et cantica*. Venetiis, apud Iuntas, 1555, p. 399.
- BERGER, P.: Hernies. In: *Traité de chirurgie*. Duplay, S. et Reclus, P., Paris, Masson, 1892, vi, 543-870.
- BONNET: See Velpeau, A. A. L. M., p. 554.
- BORDENAVE, T.: Sur le danger des caustiques pour la cure radicale des hernies. *Mém. acad. roy. de chir.*, Paris, 1774, v, 651-669.
- BOYER, A.: *Traité des maladies chirurgicales*. Paris, Migneret, 1822, viii, 1-399.
- BRYANT, T.: Strangulated hernia. *Guy's Hosp. Rep.*, Lond., 1861, vii, 44-86.
- CAMPER, P.: Sur la construction des bandages pour les hernies. *Mém. acad. roy. de chir.*, Par., 1774, v, 626-642.
- CELSUS, A. C.: *De arte medica*, editi G. P. Tiletani. Basileæ, per Ioannem Oporinum, 1552, p. 519-521.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.

- DIONIS, P.: *Traité complet des operations de chirurgie*. Par M. de la Vauguion. Paris, B. Girin, 1698, p. 75-81.
- DOWELL, G.: Subcutaneous suture for the radical cure of hernia. *Med. Rec.*, N. Y., 1866-1867, i, 265-266.
- FABRICIUS VON HILDEN, W.: *De chirurgia* edited by C. Gesner, *In: Uffenbach P., The-saurus chirurgiæ*, Francofurti, 1610, p. 1116.
- FRANCO, PIERRE: *Petit traité, contenant une des partes principales de chirurgie*. Lyon, A. Vincent, 1556, p. 11-46.
- DE GARENGEOT, R. J. C.: *Traité des operations de chirurgie*. Paris, Huart, 1731, i, 356-366.
- GERDY, P. N.: *Remarques et observations sur les hernies*. *Arch. gén. de méd.*, Par., 1836, x, 389-420.
- GUY DE CHAULIAC: *Arte medica exercitissimi chirurgia*. Lugduni, Sebastian Honoratum, 1572, p. 128.
- HALY ABBAS: *Haly filius abbas. Liber totius medicine*. Lugduni, Jacobi, 1523, p. 282; 285.
- HEISTER, D. L.: *Chirurgie*. Nürnberg, J. Hoffmanns, 1724, p. 642-650.
- HELIODORUS: See Albert, E.: p. 142-148.
- HIPPOCRATES: See Aretæus: Aretæi Cappadocis. *De causis et signis acutorum et diuturnorum, morborum, libri quatuor*. Oxoniae, Clarendoniano, 1723, p. 23-26.
- HOLTHOUSE, C.: *On hernial and other tumors of the groin*. London, Churchill, 1870.
- LANGENBECK, C. J. M.: *Abhandlung von den Leisten- und Schenkelbrüchen*. Göttingen, J. C. Dieterich, 1821.
- LAWRENCE, W.: *A treatise on ruptures*. 5th ed., Lond., Churchill, 1838.
- LE DRAN, H. F.: *Observations de Chirurgie*. Paris, C. Osmont, 1731, ii, 1-58.
- LISTER, J.: *On the antiseptic principle in practice*. *Brit. M. J.*, Lond., 1867, ii, 246-248.
- LOWE, P.: *A discourse of the whole art of Chyrurgerie*. London, T. Purfoot, 1634, p. 244-251.
- MACREADY, J. F. C. H.: *A treatise on ruptures*. London, Griffin & Co., 1893.
- MALGAIGNE, J. F.: *Examen des doctrines reçues jusqu'à ce jour sur l'étranglement des hernies*. *Gaz. méd. de Par.*, 1840, viii, 2. s., 577-582; 609-615; 641-646.
- MANLEY, T. H.: *Hernia*. Phila., Medical Press, 1893.
- MARCY, H. O.: *The anatomy and surgical treatment of hernia*. New York, Appleton, 1892.
- MCGILL, A. L.: *The treatment of the sac in herniotomy*. *Brit. M. J.*, Lond., 1883, ii, 527-528.
- ORIBASIVS: *Oribasii Sardiani. Quibus facile parabilia medicamenta*. Venetiis, V. Valgrisi, 1563, p. 156; 222.
- PANCOAST, J.: See Manley, T. p. 67.
- PARÉ, A.: *Opera chirurgica*. Paris, J. Dupuys, 1582, p. 243-249.
- PAULUS ÆGINETA: *The seven books of Paulus Ægineta*. English transl. by F. Adams. London, The Sydenham Society, 1846, ii, 372-374.
- PETIT, J. L.: *Oeuvres complètes*. Limoges, F. Chapouland, 1837, p. 608-690.
- PONCET, F.: *Un bandage herniaire à l'époque phénicienne, d'après une terre cuite trouvée à Sousse (Hadrumète) et représentant le dieu Bès ou Bizou*. *Progrès méd.*, Par., 1895, i, 358-361.
- POTT, P.: *A treatise on ruptures*. London, Hitch & Hawes, 1756.
- RABAGLIATI, A.: *Radical cure of hernia*. *Brit. M. J.*, Lond., 1884, ii, 962-963.
- REHAZES: *Opera parua Albubetri*. Lugduni, 1510, ix, clxxix.
- RICHTER, A. G.: *Abhandlung von den Brüchen*. Göttingen, J. C. Dieterich, 1785.
- ROUSSETUS, F.: *Cæsarei partus assertio historiologica*. Parisiis, D. Duvallius, 1590, p. 208-211.
- SAVIARD, B.: *Nouveau recueil d'observations chirurgicales*. Paris, J. Collombat, 1702, p. 134.
- SCARPA, A.: *Sull'ernia memorie anatomico-chirurgiche*. 2nd ed. Pavia, Dalla stamperia Fusi e co., success. Galeazzi, 1819.
- SCARPA, A.: *Traité pratique des hernies*. Trad. de l'Italien par. J. B. Cayol. Paris, Gabon, 1812.
- SCHMIDT, B.: *Die Unterleibsbrüche*. Edited by G. B. Schmidt. Stuttgart, F. Enke, 1896.
- SCULTETUS, J.: *Armamentarium Chirurgicum* xliii. Ulmae, B. Kühnen, 1655, p. 56.
- SPANTON, W. D.: *The immediate cure of inguinal hernia by a new instrument*. *Brit. M. J.*, Lond., 1880, ii, 920-921.
- VELPEAU, A. A. L. M.: *Operative surgery*. English transl. by P. S. Townsend. New York, S. S. & Wm. Wood, 1851, iii, 554.
- WERNHER, A.: *Zur Statistik der Hernien*. *Arch. f. klin. Chir.*, Berl., 1869, xi, 555-658.
- WOOD, J.: *On rupture*. Lond., J. W. Davies, 1863.
- WRIGHT, J.: *The dawn of surgery*. New York M. J., N. Y., 1923, cxvii, 483-487.
- WÜTZER, C. W.: *Ueber radicale Heilung beweglicher Leistenbrüche*. *Org. d. ges. Heilk.* Bonn, 1840, i, pt. 1.

CHAPTER IX

ANATOMY OF INGUINAL HERNIA

A thorough knowledge of the anatomy of the inguinal region is necessary in order to recognize the variations from the normal and to select the hernia operation that will give the best chance of permanent cure in each individual patient. No matter how difficult or obscure an operation may be, if the surgeon is well grounded in anatomy, he will never lose his bearings. (Fig. 23.)

Varieties of Inguinal Hernia.—Hesselbach divided inguinal hernias into the external and internal varieties, depending on their relation to the deep epigastric artery.

The external hernias are also known as “indirect” or “oblique”; the latter term, which describes the oblique position taken by the hernia in its passage from the internal to the external ring, is the one most commonly used.

The internal hernias which pass between the deep epigastric artery and the edge of the rectus muscle are generally known as direct hernias, because they come directly through the abdominal wall, internal to the internal abdominal ring.

The Inguinal Canal.—The inguinal canal is an oblique opening about an inch and a half (3.75 cm.) long, and is situated parallel to the inner half of Poupart’s ligament and a little above it. It is directed downward and inward and extends from the internal or deep abdominal ring to the external or superficial abdominal ring. It is one and a half inches (3.75 cm.) long in the male, and two inches (5 cm.) long in the female, the greater length in the female being due to the wider separation of the iliac bones. In large hernias the obliquity of the canal diminishes and the two rings almost meet.

In the male, after the descent of the testis at about the sixth month, the canal contains the ilioinguinal nerve, the genital branch of the genito-crural nerve, and the spermatic cord; in the female, it contains the round ligament, the ilioinguinal nerve, and the genital branch of the genito-crural nerve. The anterior and posterior walls of the canal run obliquely downward, inward and forward, and lie in apposition except for the space occupied by the cord or the round ligament.

The inguinal canal is bounded in front by the aponeurosis of the external oblique throughout its entire length, and by the lower fibers of the internal oblique at its outer third; behind, by the triangular ligament of the abdominal wall at its inner end, and by the conjoined tendon and transversalis fascia; above, by the arched fibers of the internal oblique and transversalis muscles; below, by Poupart’s ligament, as far as the posterior shelv-

ing margin which gives attachment to the transversalis fascia; and at its inner end by Gimbernat's ligament. This lower boundary is sometimes called the posterior wall of the inguinal canal. Many anatomists describe three reinforcing fasciae: The ligament of Henle, the ligament of Hesselbach, and the iliopubic band.

The Inguinal Canal in Infants.—In infants the obliquity of the inguinal canal is slight because it passes almost directly through the abdominal wall.

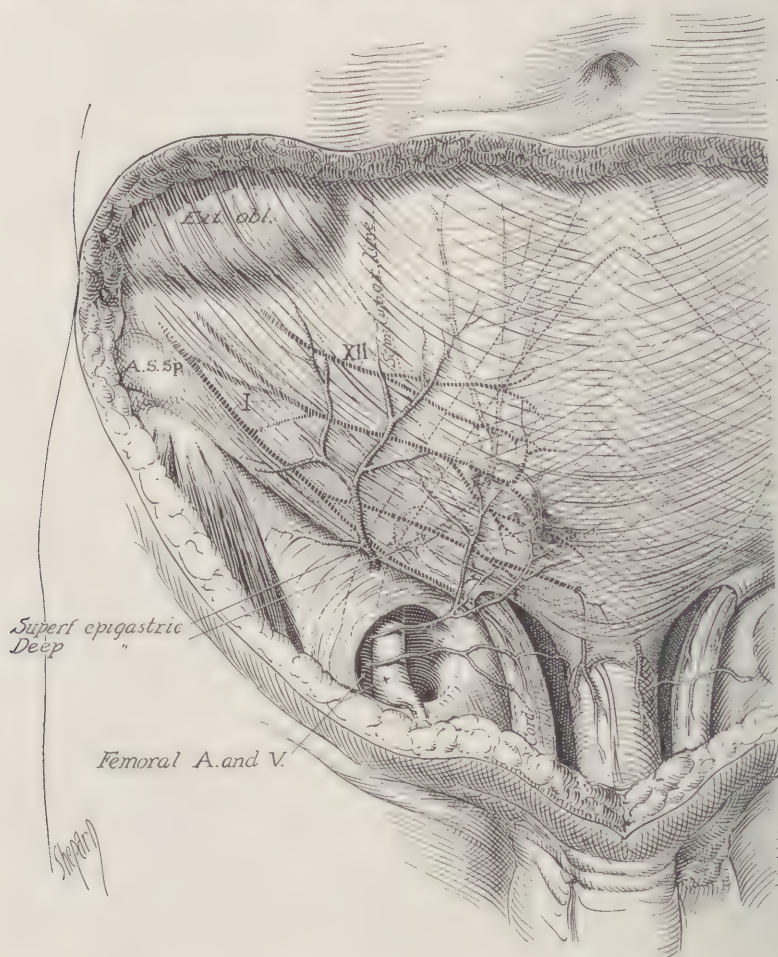


Fig. 23.—The superficial anatomy of the inguinal and femoral regions. Showing the muscles and fasciae, and the course of the blood vessels and nerves encountered during the operation for inguinal and femoral hernia.

The External, Superficial or Subcutaneous Abdominal Ring.—The external ring or opening in the aponeurosis of the external oblique is located just above and to the outer side of the crest of the os pubis. This aperture is oblique in direction, triangular in shape, and usually measures about an inch (2.5 cm.) from base to apex, and about half an inch (1.25 cm.) from side

to side. It is bounded below, by the crest of the os pubis; above, by the curved intercolumnar fibers, which pass across the upper angle of the ring to increase its strength; on either side, by the margins of the opening in the aponeurosis, which are called the columns or pillars of the ring. The external or inferior pillar, which is formed from the part of the aponeurosis that is inserted into the pubic spine, is narrow, and curved to form a groove upon which the spermatic cord rests in the male. The internal or superior pillar is that part of the aponeurosis that lies internal to the ring and is attached to the crest and symphysis pubis.

The normal external ring will seldom admit the tip of the little finger and it is impossible to palpate the inguinal canal or the internal ring. When the external ring is large the cremaster muscle is well developed, apparently an attempt of Nature to make up for the weakness in the aponeurosis of the external oblique.

The Internal or Deep Abdominal Ring.—The internal ring can be located on the external abdominal wall by a circle $\frac{3}{4}$ of an inch (2 cm.) in circumference, placed about $\frac{3}{4}$ of an inch (2 cm.) above the middle of Poupart's ligament.

It is an oval opening situated in the transversalis fascia midway between the anterior superior spine of the ilium and the symphysis pubis, about $\frac{1}{2}$ inch (1.25 cm.) above and slightly external to the middle of Poupart's ligament. It is bounded above and externally, by the arched fibers of the transversalis muscle, and below and internally, by the deep epigastric vessels. From the circumference of the internal ring, a thin funnel-shaped membrane, the infundibuliform fascia, continues around the cord and testis, enclosing them in a distinct pouch. This fascia constitutes one of the coverings of an oblique inguinal hernia. The internal abdominal opening is located in the extraperitoneal fatty tissue.

The Nerves of the Inguinal Region.—The hypogastric branch of the iliohypogastric and the inguinal branch of the ilioinguinal are the nerves encountered in the ordinary operation for inguinal hernia. The genital branch of the genitoocrural lies behind the cord and accompanies it through the inguinal canal.

The Iliohypogastric Nerve.—The hypogastric branch of the iliohypogastric nerve is larger than the iliac branch and is often double, and pierces the internal oblique muscle on a level with the anterior superior spine of the ilium. It then runs inward and downward on the internal oblique about $\frac{1}{2}$ inch (1.25 cm.) above and internal to the inguinal canal, finally passing through the aponeurosis of the external oblique just above the external ring.

The Ilioinguinal Nerve.—The ilioinguinal nerve pierces the internal oblique below and one inch (2.5 cm.) to the inner side of the anterior superior spine. It runs downward and inward over the cremaster muscle just above Poupart's ligament, emerging through the external ring, and supplies cutaneous branches to the scrotum or the labium majus.

The Genitocrural Nerve.—The genital branch of the genitocrural nerve accompanies the cord, or the round ligament, through the inguinal canal and the internal and external rings and supplies branches to the cremaster muscle. The inclusion of this nerve in the sutures gives rise to pain along the cord, while suturing of the iliohypogastric or ilioinguinal nerves will cause a neuritis, or persistent pain in the inguinal region.

The Deep Epigastric Artery.—The deep epigastric artery runs upward and inward toward the umbilicus, from a point midway between the anterior superior spine of the ilium and the symphysis pubis. This artery ascends obliquely along the inner margin of the internal or deep abdominal ring, where it lies between the transversalis fascia and the peritoneum, passes upward piercing the transversalis fascia, and enters the sheath of the rectus muscle by passing over the semilunar fold of Douglas.

The Conjoined Tendon.—The conjoined tendon of the internal oblique and transversalis was described by Morton in 1841, and by Roustan in 1843. This tendon is usually triangular in shape with its base inserted into the crest of the pubis and the pectineal line. It is situated immediately behind the inguinal canal and the external abdominal ring, thus protecting a weak point in the abdominal wall. In direct inguinal hernia the conjoined tendon may form one of the coverings of the sac.

Blake dissected twenty-five normal muscular subjects, and found no instance where the conjoined tendon extended for more than $\frac{7}{8}$ of an inch (1.5 cm.) laterally from the insertion of the rectus muscle; in the majority it was less than $\frac{1}{2}$ inch (1.25 cm.) and in some it was inappreciable.

The Inguinal Fossae.—Each half of the inner surface of the anterior abdominal wall in the inguinal region presents three distinct fossae, which are of clinical interest in the study of the relation of the parietal peritoneum to the different varieties of inguinal hernia:

1. The internal inguinal fossa (fovea supravesicalis) is bounded internally, by the median cord (plica urachii); externally, by the obliterated hypogastric artery (plica hypogastrica); and below, by the bladder. Direct hernia may occur through this fossa, but it is very rare.

2. The middle inguinal fossa (fovea inguinalis mesialis) is bounded internally, by the obliterated hypogastric artery (plica hypogastrica); externally, by the deep epigastric artery (plica epigastrica); and below by Poupart's ligament. As a rule, direct inguinal hernia makes its exit through this fossa.

3. The external inguinal fossa (fovea inguinalis lateralis) is the small depression in the peritoneum just to the outer side of the deep epigastric artery (plica epigastrica), which marks the internal opening of the deep or internal abdominal ring. The spermatic cord leaves the abdomen through this ring, and it is the route taken by indirect or oblique inguinal hernia. (Fig. 24.)

There are other anatomical structures which are of importance in the

study of hernia, but as they are fully described in any textbook on anatomy, they will only be mentioned here: Poupart's ligament (inguinal ligament), the external oblique muscle and aponeurosis, the internal oblique, transversalis, cremaster and rectus muscles, the transversalis, intercolumnar, and triangular fasciae, the superficial layer of abdominal fascia (fascia of Camper) and the deep layer of superficial fascia (fascia of Scarpa).

Descent of the Testicle.—Little has been added to our knowledge of the descent of the testicle since the observations published by John Hunter in

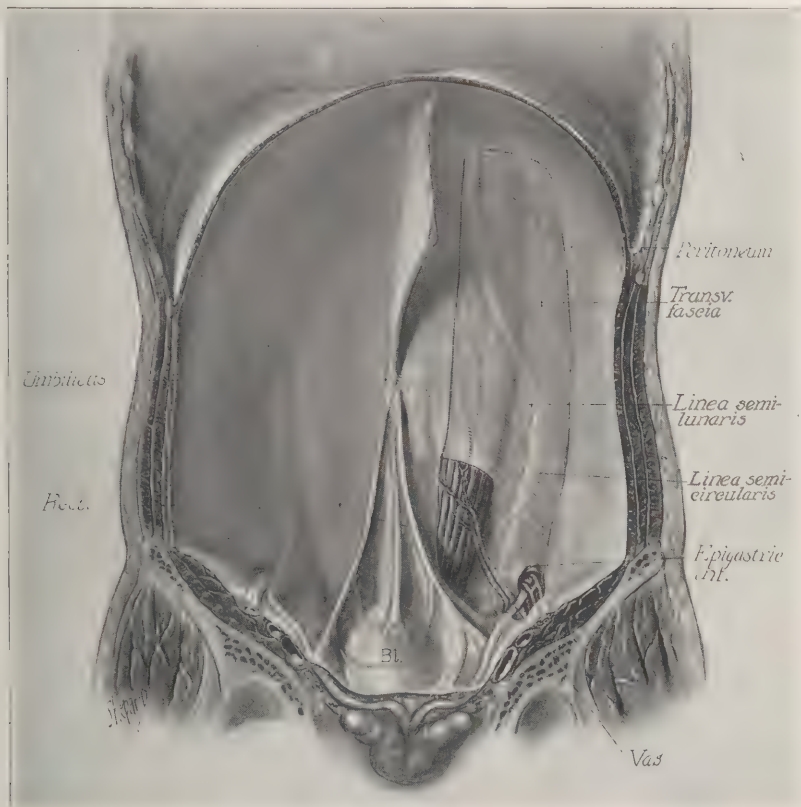


Fig. 24.—Posterior view of the anterior abdominal wall. Showing the inguinal fossae, the bladder, deep epigastric vessels, and the deep anatomy of hernia of the lateral abdominal wall.

1762. The following description closely follows Piersol and Keith: In early fetal life the testes are located at the back part of the abdominal cavity, behind the peritoneum and below the kidneys, about on a level with the upper lumbar vertebrae. (Fig. 25.) The anterior surface and sides are covered with peritoneum. By the second fetal month the testis and epididymis are attached to the genitoinguinal ligament. This ligament, which is at first a slender band, soon becomes well defined, and stretches from the testis to the lower part of the anterior abdominal wall where the scrotum is later formed. During the third fetal month the testis, guided by the ligament, descends to a position

which corresponds to the internal abdominal ring. With advancing growth, the peritoneum covering the testis envelops it entirely and forms a mesentery, and the muscular fascial and peritoneal layers of the anterior abdominal wall show a protrusion which results in the production of a sac—the inguinal bursa. This deepens and extends into the scrotal fold, which meanwhile is formed independently as an integumentary fold. The genitoinguinal ligament, being attached to the structures undergoing invagination, extends into the inguinal bursa. The muscular tissue of the wall of the bursa is derived from the internal oblique and transversalis, and constitutes the cremaster. The lining of the inguinal bursa is the direct continuation of the general serous membrane of the abdominal cavity, and later it constitutes the processus vaginalis peritonei. By the fifth month the upper part of the genitoinguinal ligament has disappeared and the lower portion has become a thick

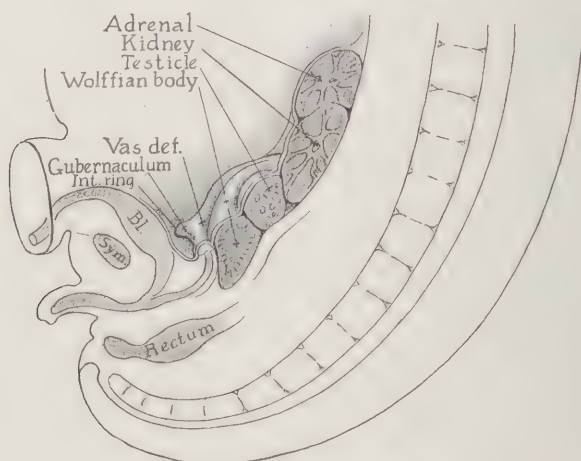


Fig. 25.—Descent of the testicle. In early fetal life the testes are located at the back part of the abdominal cavity, behind the peritoneum and below the kidneys, about on a level with the upper lumbar vertebrae.

cord and produces an elevation of the floor of the bursa—the inguinal conus. During the seventh and eighth months the inguinal conus and attached testis are drawn downward into the inguinal canal and through it, until shortly before birth the testis reaches its position in the scrotum. (Fig. 26.)

The inguinal conus and the genitoinguinal ligament constitute the gubernaculum testis, which becomes shorter and smaller as the testis descends. The remains of the gubernaculum testis constitute the scrotal ligament, the subserous band which permanently attaches the tunica vaginalis and testicle to the surrounding tissue of the walls of the scrotum.

The retroperitoneal position of the testis is always retained, the testis and the accompanying constituents of the spermatic cord descending outside of the peritoneal pouch, which extends into the scrotum. For a time free intraabdominal communication is maintained by the now tubular processus

vaginalis; usually, however, by the time of birth, or shortly after, this canal is obliterated, the isolated, lower end of the peritoneal process persisting as the pouch of the tunica vaginalis which almost surrounds the testis.

The Processus Vaginalis.—The processus vaginalis is the entire process of peritoneum that accompanies the testis and cord. It is divided into two

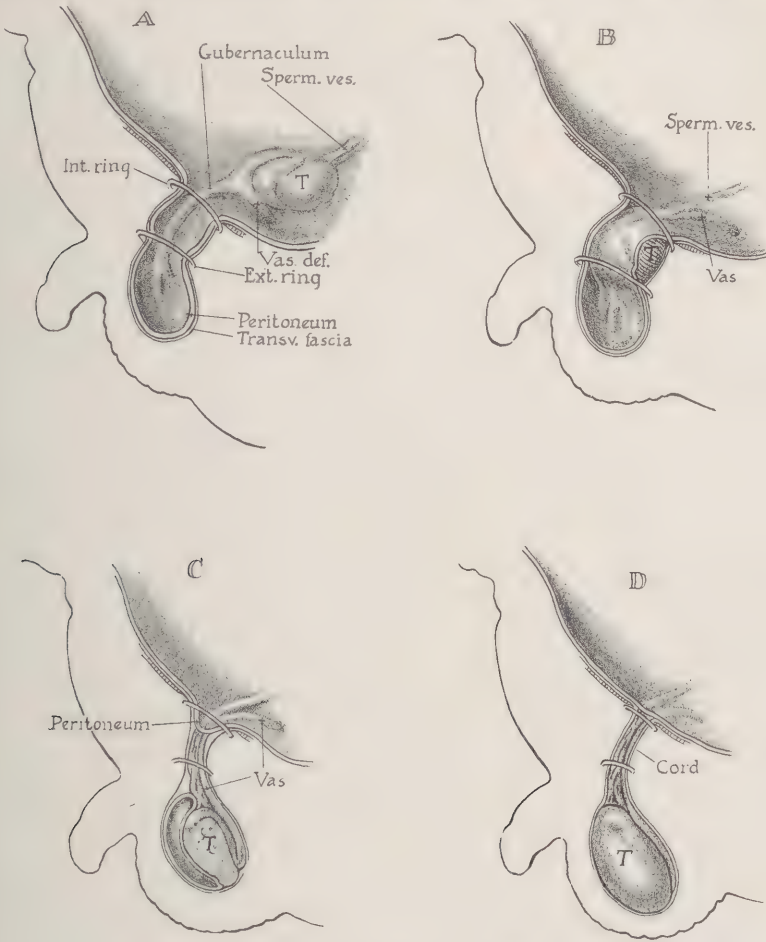


Fig. 26.—Descent of the testicle.

a. The testicle still in the abdominal cavity. Note the gubernaculum testis which precedes the testicle in its descent.

b. The testicle in the inguinal canal. The gubernaculum becomes shorter and shorter as the testicle advances.

c. The testicle in the scrotum. The processus vaginalis is obliterated to a point below the external ring.

d. The testicle in its normal position in the scrotum. The processus vaginalis completely obliterated.

portions: The funicular process, which invests the cord, and the tunica vaginalis testis, which surrounds the testis.

The processus vaginalis or funicular process, which appears at the third month of intrauterine life, is a canal or peritoneal diverticulum that entirely

surrounds the testis and its epididymis, and is continuous with the peritoneal cavity. The relation of the processus vaginalis to the testis has been a subject of considerable controversy: Kölliker and Henle believed that the processus vaginalis is formed before the descent of the testis and that it has no relation to the latter. This theory has been generally abandoned following the investigations of Bramann, Sachs, Russell, Murray and others, who demonstrated that the processus vaginalis does not exist before the descent of the testis, and that the gubernaculum testis is responsible for the migration of the testis and also for the descent of the processus vaginalis, which reaches the bottom of the scrotum in advance of the testis.

Whatever may be the mode of its formation, the funicular process tends to become obliterated after birth. Hunter believed the obliteration begins in the upper part of the vaginal process; Jarjavay thought it started in the middle part; Féré maintained that the lower portion is the first to close. In

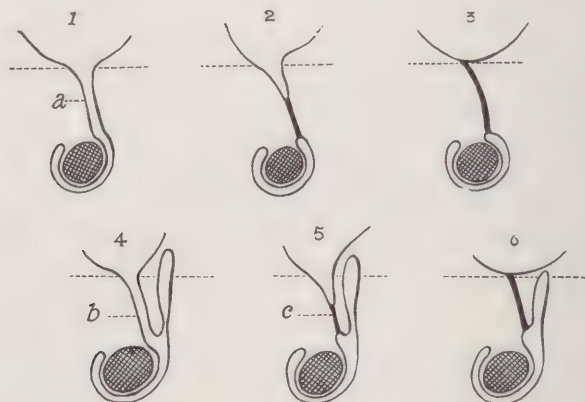


Fig. 27.—The processus vaginalis.

1. Completely open funicular portion. *a.* Funicular portion of processus vaginalis. 2. Partially-closed funicular portion. 3. Normal closure of processus vaginalis. 4. Hernia magna. *b.* Completely-open funicular portion. 5. Infantile hernia. *c.* Partly-closed funicular portion. 6. No hernia, but potential large hydrocele. (R. H. Russell).

women, patency of the canal of Nuck is a cause of congenital hernia; however, this condition is rare, because of the narrowness of the canal and the small internal opening. (Fig. 27.)

Patency of the Processus Vaginalis.—Camper, in 1785, in a series of dissections in infants, found the processus vaginalis open on a single side in 31.5 per cent of the subjects, and open on both sides in 45 per cent. Féré examined 72 infants and found an obliteration of the funicular process 34 times. Keith stated that in children 3 to 4 months old, the processus vaginalis is open in 30 to 40 per cent of all cases. In infants under 4 months old, Sachs found obliteration in 41 per cent, and permeability in 30 per cent. After the fourth month the percentage of closures was higher, obliteration being found in 69 per cent, and permeability in only 4 per cent. Ramonède examined

215 adult subjects and found abnormalities in the processus vaginalis in 15 per cent.

In 1899 Russell stated that all inguinal hernias in both adults and children were congenital in origin and were due to a persistent patent funicular process. All degrees of patency may be encountered. Longitudinal diverticula have been observed. Transverse partitions in the processus vaginalis are not uncommon. I have found four distinct loculi in one sac with pin-hole openings connecting each compartment.

Microscopical Examination of the Sac.—Microscopical examination of a hernial sac shows that it consists of a thin lining of endothelium lying on a thick layer of dense fibrous tissue.

Hertzler remarks that one of the strongest evidences of the sac being preformed is afforded by an examination of the connective tissue at the point of union of the sac and cord. Microscopical examination will show an interlacement of fibrils running parallel to the walls of the sac and continuing over the cord, but separated entirely from other surrounding tissue. In several hernias of less than five days' duration, microscopical examination showed that the union of the sac to the cord was made up of fully developed fibrous tissue free from cellular infiltration.

The Obliteration of the Processus Vaginalis.—The obliteration of the processus vaginalis occurs at two points, first at the internal abdominal ring, and a little later at a point just above the epididymis. Between these points, the processus vaginalis is an isolated tube which becomes smaller, its walls are occluded, and it finally terminates in a small fibrous cord, which is easily recognized during dissection or operation.

If the processus vaginalis does not become obliterated, a congenital hernial sac results, which may become a hernia, either at birth or in later life. During their descent the testis and spermatic cord obtain more or less extensive investments of such parts of the abdominal walls as have taken part in the formation of the original bursa inguinalis.

From within outward these coverings are:

1. Peritoneum, after obliteration of the stalk of the peritoneal pouch, however, coextensive only with the tunica vaginalis.
2. Infundibuliform fascia (tunica vaginalis communis), continued from the transversalis fascia.
3. Cremasteric fibers, from the transversalis and internal oblique muscles, blended by areolar tissue into the cremasteric fascia.
4. Intercolumnar fascia, from the aponeurosis of the external oblique.
5. Superficial fascia or tunica dartos.
6. Skin.

Unusual attachments of the gubernaculum below, to the tuber ischii and sphincter ani, account for some forms of testicular ectopia.

The lower or growing end of the gubernaculum testis is composed of rapidly proliferating cells, while the upper end consists of nonstriated mus-

cle tissue attached to the globus minor and mesentery of the testis. (Keith.) When the lower growing end of the gubernaculum testis is diverted from its course, it may carry the testis toward the pubis outwards, into the groin, or backwards into the perineum.

The attachments of the gubernaculum above to the peritoneum of the cecum, ileum, or sigmoid, or to the loosely attached peritoneum lining the iliac fossa, account in part for the formation of the sac in infantile hernia.

The firmness of the attachments of the gubernacula to the testes and to the dartos is shown by the fact that in large hydroceles and elephantiasis scroti, the testes will usually be found near the lower extremity or fundus of the tumor.

Undescended Testis (Detention, Retention or Arrested Testis).—The undescended testis fails to descend into its normal position in the scrotum.

Varieties of Undescended Testis.—The varieties of undescended testis are:

1. The abdominal, in which the testis is retained within the abdominal cavity.
2. The inguinal, in which the testis is arrested in the inguinal canal.
3. The pubic, in which the testis rests in front of the pubic bone just below the external ring.
4. The scrotal, in which the testis remains in the upper part of the scrotum.

The Maldescended or Ectopic Testis.—The ectopic testis descends into an abnormal position, owing to an anomalous attachment of the gubernaculum testis (see descent of the testis).

The Varieties of Maldescended or Ectopic Testis.—1. The inguinoperineal, in which the testis passes upward and outwards from the external ring in the direction of the anterior superior spine, and lies on the aponeurosis of the external oblique.

2. The pubopenile, in which the testis passes inwards from the external ring over the pubis to the root of the penis.

3. The crural or cruroscrotal, in which the testis rests in the upper part of Scarpa's triangle, or more often, in the fold between the scrotum and the thigh.

4. The perineal, in which the testis migrates into the perineum behind the scrotum. Described by Goyrand in 1834.

5. The transposed or crossed testis, in which the testis migrates intraperitoneally to the opposite side, and from there passes into the inguinal canal and scrotum.

Hernia and Testis Passing through the Femoral Ring into the Scrotum—(**Inguinofemoral or Cruroscrotal Hernia**).—Scrotal hernia passing through the femoral ring is very rare. Adams operated on a small scrotal hernia in a boy, five years old, and found the inguinal canal empty. He opened the tunica vaginalis in the scrotum, followed the sac and cord upward and found that they passed into the abdomen through the femoral ring.

Fauntleroy encountered an interesting case in a man, 22 years of age. At examination a left scrotal hernia was found. There was no cord in the inguinal canal, and on coughing no impulse was felt at the external ring. Operation showed that the cord and hernial sac from the internal ring had passed downward beneath the internal oblique muscle and Poupart's ligament through the femoral ring into the scrotum. The sac was ligated and excised at the internal ring. The internal oblique was sutured to Poupart's ligament, and the femoral opening, containing the cord, was narrowed by suturing Poupart's ligament to Cooper's ligament. A few similar cases are reported in the literature.

Classification According to Etiology.—From an etiologic standpoint, inguinal hernias are divided into two groups, the congenital (intrafunicular) and the acquired (extrafunicular).

1. Congenital inguinal hernia is always of the oblique variety, and the sac is found intimately adherent to the vas deferens and to other cord structures.

2. Acquired inguinal hernias comprise all direct hernias, traumatic hernias through the external inguinal fossa, and those that escape through a rent in the transversalis fascia. In acquired hernia the sac is not adherent to the vas deferens or to other cord structures, and it may be some distance away.

Mechanism of Hernia.—The obliquity of the inguinal canal is a natural obstacle to hernia, because an increase in intraabdominal tension forces the inguinal walls more firmly together. When a patient strains, the conjoined tendon and transversalis contract vigorously, and if a finger is inserted in the inguinal canal, it is firmly gripped between the conjoined tendon and Poupart's ligament. Keith stated that intraabdominal pressure is raised to 100 mm. of mercury by straining or lifting. True acquired hernias or acquired congenital hernias (hernias into a preformed sac) usually follow a sudden increase in intraabdominal tension which is sufficient to overcome the resistance offered by the valve-like action of the inguinal canal.

In addition, there are often predisposing causes, such as a patent processus vaginalis, a depression in the infundibuliform fascia, a weak point in the abdominal wall, congenital or acquired weakness of the abdominal muscles, emphysema, long-continued increased intraabdominal tension, prostatic disease or urethral stricture.

The importance of malformation of the pillars of the external ring, as a predisposing factor, is generally unappreciated. Marked phimosis may possibly have an influence in some cases. Elongation of the mesentery is no longer believed to be a predisposing cause of hernia; the lengthening of the mesentery is acquired as the scrotal hernia is formed. In the cadaver, with the inguinal canal opened, intestine cannot be drawn into the scrotum on account of the shortness of the mesentery.

Formation of Oblique Inguinal Hernia.—It is generally believed that all oblique inguinal hernias are due to a preformed sac which consists of an unobliterated portion of the processus vaginalis. Given an exciting cause that increases intraabdominal tension, the preformed sac together with a knuckle of small intestine or a piece of omentum is forced through the internal ring. The sac enters the inguinal canal above the cord, and descends in front of it. While a slight bulge over the internal ring may remain unchanged in size for years, once the sac has passed the ring it has overcome the point of greatest resistance, and its progress down the inguinal canal is rapid. If the pillars of the external ring are well developed and the opening only large enough to allow the passage of the cord, the hernia may be temporarily checked in its descent at this point. Beyond the external ring, the coverings of the sac exert only very little resistance and the hernia quickly

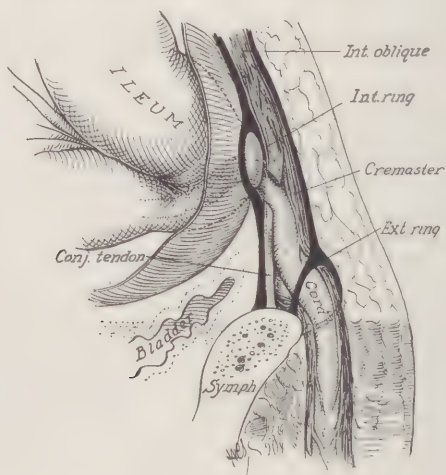


Fig. 28.—Formation of oblique inguinal hernia. A slight bulge at the internal abdominal ring. Note the obliquity of the inguinal canal which is an actual obstacle to the development of hernia.

descends to a position opposite the upper level of the testis, where the firm connections between the coverings of the cord and the tunica vaginalis may check its progress. If it overcomes the resistance here, it usually goes to the bottom of the scrotum and is known as a scrotal hernia. (Figs. 28, 29, 30, 31 and 32.)

In complete hernias, descent is probably aided by the weight of the hernial contents and by the mesentery which elongates and ceases to lend its support to the intestines. In females the hernia follows the round ligament through the inguinal canal into the labium majus.

Varieties of Oblique Inguinal Hernias.—The oblique inguinal hernias leave the abdomen through the internal ring, and are of three varieties, according to the degree of descent of the sac, namely, incomplete, complete, and scrotal.

1. In the incomplete variety (bubonocoele) the sac remains in the inguinal canal.
2. In the complete variety, the hernial sac emerges from the inguinal canal at the external ring.
3. In the scrotal variety, the hernia passes down into the scrotum.

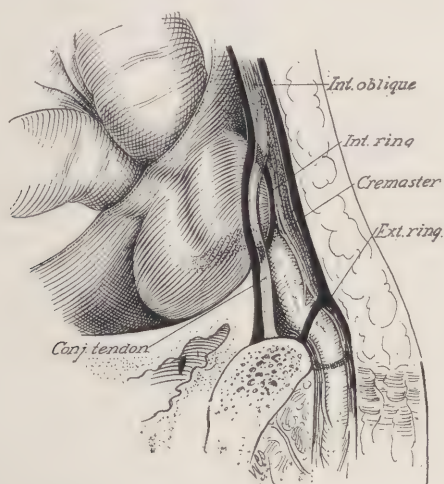


Fig. 29.—Formation of oblique inguinal hernia. The relaxation of the peritoneum and the dilatation of the internal abdominal ring.

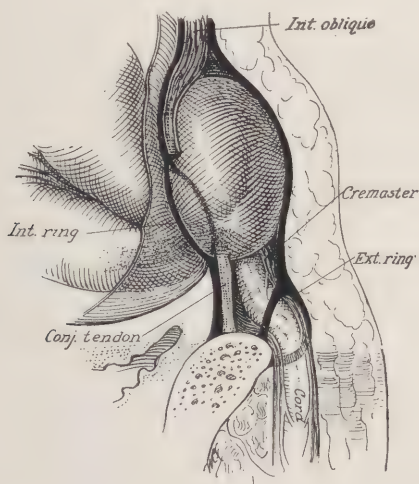


Fig. 30.—Formation of oblique inguinal hernia. Showing the dilatation of the inguinal canal.

Oblique inguinal hernias are also classified into the congenital, infantile, and funicular varieties, according to the degree of patency of the processus vaginalis. Numerous anomalies in the closure of the processus vaginalis have been observed from time to time, and have given rise to elaborate descriptions in the literature of unimportant subdivisions of these three varieties.

1. **Congenital Hernia.**—In congenital inguinal hernia the vaginal process is entirely open and continuous with the abdominal cavity, and the sac envelops both the hernial contents and the testis which lie in contact with each other. Congenital hernia is rarely present at birth, but is first observed in

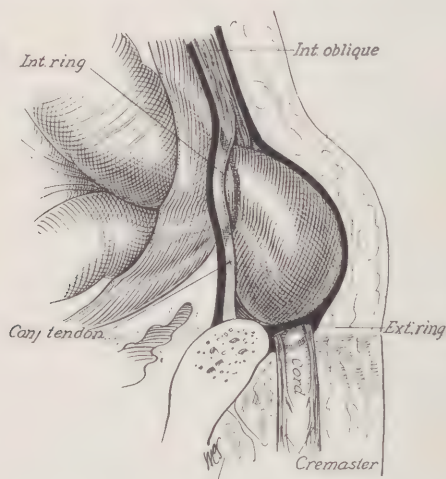


Fig. 31.—Formation of oblique inguinal hernia. The dilatation of the inguinal canal completed. The hernia has reached the external ring.

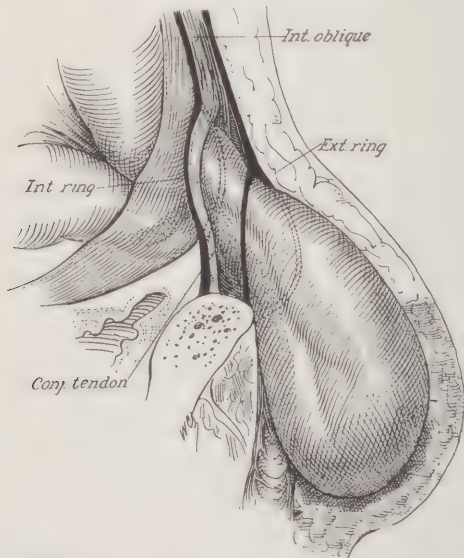


Fig. 32.—Formation of oblique inguinal hernia. The hernia has passed the external ring and descended into the scrotum.

infancy, as a rule, following a strain which forces the intestine down into the sac. (Fig. 33.)

2. **Infantile or Encysted Hernia—(Hernia with a Double Sac).**—Infantile and encysted hernia are identical. This hernia was first observed by Méry

and Petit in 1701, by LeCat in 1753, and in 1764 it was fully described by Hey, who called it infantile hernia, probably because the case he observed was in an infant. Later, Cooper found this hernia associated with a hydrocele and named it encysted hernia. The only difference in Hey's and Cooper's cases was that in Hey's case the tunica into which the hernia protruded was empty, and in Cooper's case the tunica vaginalis contained a hydrocele.

In infantile or encysted hernia the processus vaginalis is closed only at the internal ring. Intraabdominal pressure aided by the descent of the testis, causes a sac or pouch of peritoneum to descend in front of the cord or vaginal process; or what usually happens is an invagination of the hernial sac into

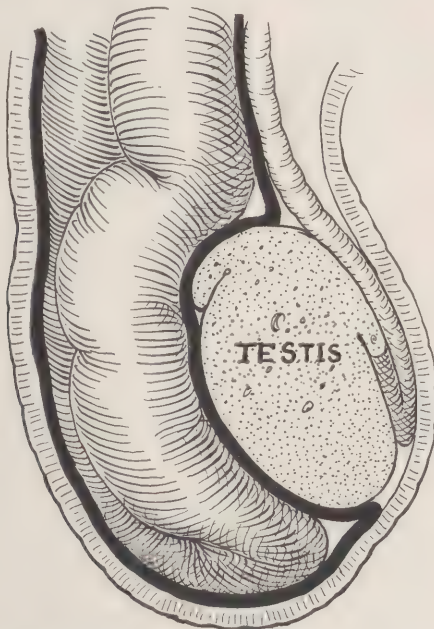


Fig. 33.—Congenital hernia. The vaginal process is entirely open and continuous with the abdominal cavity. The sac envelops both the hernial contents, and the testes which lie in contact with each other.

the sac of a hydrocele. These hernias have three layers of serous membrane between the sac contents and the skin, the peritoneal sac, and two layers of tunica vaginalis. These are connected with each other at the neck of the sac, and as pointed out by Moschcowitz, the sacs cannot be separated. (Figs. 34 and 35.)

Russell remarked that many so-called infantile hernias are simply the result of an accident of taxis. A rent in the peritoneum near the neck of the sac allows the intestine to come down beside the sac.

Important papers on this subject have been published by Monod, Terrillon, Clarac, Moynihan, Jaboulay, Kurtzhalss, Kaiser, and Moschcowitz.

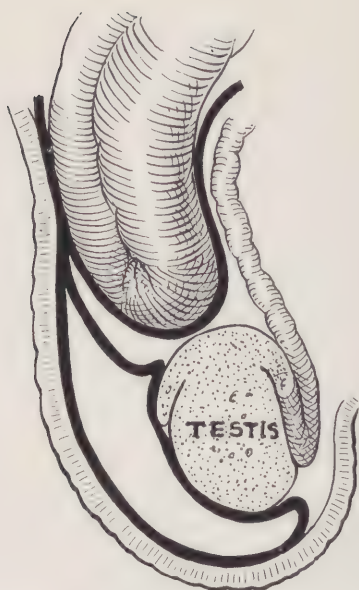


Fig. 34.—Infantile hernia. The processus vaginalis is closed only at the upper end.

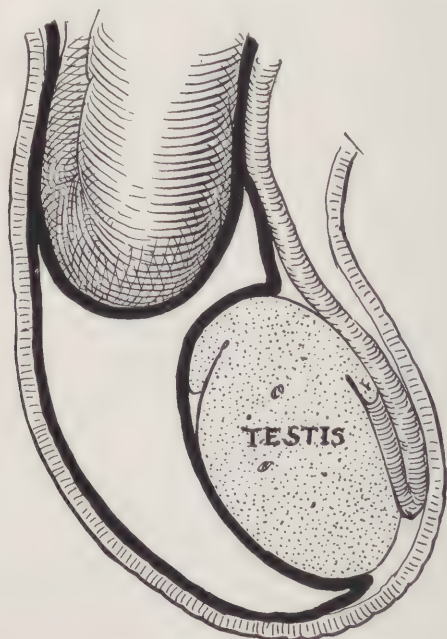


Fig. 35.—Infantile hernia (encysted type). This condition is usually caused by the invagination of a hernial sac into the sac of a hydrocele.

3. Funicular Hernia.—In funicular hernia the processus vaginalis closes only at its lower end just above the epididymis, while the peritoneal diverticulum or funicular process is continuous with the peritoneal cavity, and is

open from the deep abdominal ring to the epididymis. The hernial contents are separated from the testis by the septum formed at the point of obliteration, the normal tunica vaginalis. (Fig. 36.)

The Canal of Nuck.—A peritoneal diverticulum in the inguinal canal in women, which was first described by Nuck in 1672, and corresponds to the processus vaginalis testis in man, is the cause of oblique inguinal hernia in females. The canal of Nuck is normally obliterated about the seventh month of intrauterine life, earlier than in the case with the processus vaginalis testis. The patency of this process was noted in 18 per cent of the subjects examined by Féré, in 24 per cent of those examined by Zuckerkandl, and in 25 per cent of those examined by Sachs.

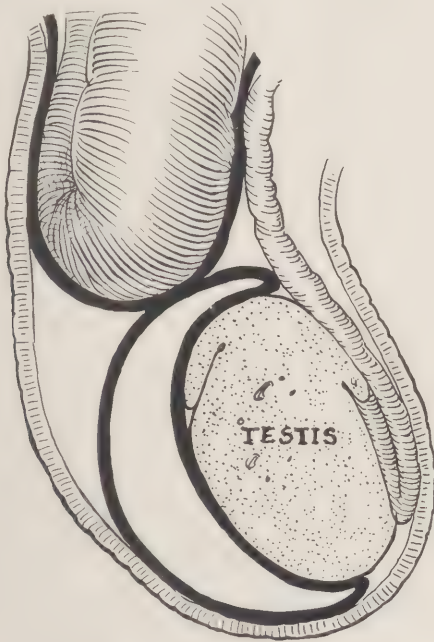


Fig. 36.—Funicular hernia. The processus vaginalis is closed only at its lower end. The hernial contents are separated from the testis by the obliterated portion of the processus vaginalis, the normal tunica vaginalis.

The Gubernaculum in the Female.—In the female, also, there is a gubernaculum that influences the position of the ovary to a certain extent. The remains of the gubernaculum lying between the attachment of the cord to the uterus and its termination in the labium majus, form the round ligament of the uterus.

Oblique Inguinal Hernia in the Female.—The inguinal canal in the female is longer and narrower than in the male. It gives passage to the round ligament and its vessels, to the genital branch of the genitocrural nerve, and sometimes to a peritoneal diverticulum (the canal of Nuck). After leaving the external ring the hernia passes into the upper part of the labium majus.

If it remains incomplete, it is a bubonocoele or pubic hernia, and its oval or globular shape resembles a direct inguinal hernia in the male. Incomplete hernia is the form commonly found in the female, and it does not become labial, as frequently as oblique inguinal hernia in the male becomes scrotal. Bianchetti has studied in detail the anatomy of oblique inguinal hernia in the female.

Coverings of Oblique Inguinal Hernia.—The coverings of oblique inguinal hernia are of interest to the anatomist, but of little value to the surgeon, save in exceptional cases where they may serve as landmarks. They are usually so matted together, in inflamed or old hernias, that the layers cannot be identified. A complete oblique inguinal hernia has the following coverings: (1) The extraperitoneal connective tissue; (2) the infundibuliform fascia (transversalis); (3) the cremaster muscle; (4) the intercolumnar fascia (from external oblique aponeurosis); (5) the superficial fascia—the dartos in scrotal hernia; and (6) the skin.

The Deep Epigastric Artery.—The deep epigastric artery is an important landmark in the anatomy of inguinal hernia and it may be outlined on the abdomen by drawing a line from a point midway between the anterior superior spine and the symphysis, to a point on the outer edge of the rectus abdominis muscle midway between the umbilicus and the symphysis pubis. Hernias lying external to the epigastric artery are known as oblique, while those internal to the vessel are direct. Macaggi described a rare type of direct hernia in which the epigastric vessels are in the hernial sac.

Hesselbach's Triangle.—Hesselbach's triangle is bounded on the outer side by the deep epigastric artery, on the inner side by the rectus muscle, and below by Poupart's ligament.

Direct or Internal Inguinal Hernia (Hesselbach's Hernia).—Direct inguinal hernia is so named because it takes the most direct route through the abdominal wall, passing through only the lower fifth of the inguinal canal. It is sometimes called internal inguinal hernia because of its position internal to the deep epigastric artery. It is also called straight hernia.

Direct hernias usually break through into the inguinal canal because the resistance is less in that direction than it is inward toward the rectus muscle. These hernias are never congenital and they have no preexisting path. They are of slow development and ordinarily occur in adults. They are characterized by a small sac with a relatively large opening, and because of the shortness of the neck of the sac, they are globular in shape. Direct hernias generally remain bubonocoeles, and on reduction go directly backward into the abdomen. The abdominal opening is easily felt, as it has the outer edge of the rectus muscle to the inner side and the crest of the pubis below. Direct hernias rarely descend into the scrotum.

The abdominal wall over the middle fossa is strengthened by the rectus muscle, which is attached to the pubic crest, and also by the triangular (Colles') ligament, which consists of the inner or deeper fibers of Poupart's

ligament that turn upward and inward from the crest of the pubes in front of the insertion of the conjoined tendon. This ligament passes behind the internal pillar of the external ring and is inserted into the anterior sheath of the rectus and into the linea alba; it protects the inner and posterior wall of the canal in the angle between the pubes and the rectus muscle, and far enough outward to correspond to the inner third of the external ring in males, and to the inner half of the external ring in females (Malgaigne).

The Weak Spot.—The weak spot of the middle fossa is the usual point of exit of direct hernia. It is directly behind the lower fifth of the inguinal canal and the upper edge of the external ring between the outer edge of the rectus muscle and the deep epigastric artery, at a point where the abdominal wall contains no muscular layer, being weakened anteriorly by the gap in the external oblique aponeurosis at the external ring. The thinnest point, however, is at the upper and outer angle of the external ring where the posterior wall of the canal is not reenforced by the conjoined tendon or the triangular (Colles') ligament.

The weak spot is bounded internally, by the aponeurotic fibers of the transversalis muscle which run from the upper surface of the pubis to the rectus; and externally, by similar fibers from the transversalis muscle which encircle the inner border of the internal ring, and fuse with the inner surface of Poupart's ligament. Spalteholz stated that when these aponeurotic fibers are broad the weak spot is narrow, and when they are poorly developed the weak spot is wide. This spot is weaker than any place in the external inguinal fossa.

Points of Exit of Direct Hernia.—A direct inguinal hernia may escape through two routes:

1. Through the middle fossa, between the plica epigastrica and the plica hypogastrica, around the outer edge of the conjoined tendon, where it enters the canal below the internal ring. This variety of direct hernia has the same coverings as an oblique hernia, except that in direct hernia, the general transversalis fascia replaces the infundibuliform fascia of the oblique variety. (Fig. 37.)

2. A direct inguinal hernia may escape through the outer part of the internal or suprapubic fossa, which lies between the plica urachii and the plica hypogastrica; the outer and deepest part of the internal fossa corresponding to the external ring. The hernia passes around the edge of the conjoined tendon and the triangular ligament, or, if these structures are thin and poorly developed, it may carry them with it, so that its coverings would be: (a) Extraperitoneal connective tissue; (b) transversalis fascia; (c) conjoined tendon; (d) triangular (Colles') ligament; (e) intercolumar fascia; (f) superficial fascia and (g) skin.

Relation of the Spermatic Cord to the Sac.—The spermatic cord does not accompany a direct hernia, but usually lies some distance to the outer side of the sac.

Double Direct Hernias.—Double direct hernias on the same side have been seen but they are very rare. Corlette observed at operation, two direct inguinal hernias on the same side in a man, aged 56 years.

Relation of Direct Hernia to the Linea Semilunaris.—Direct hernia is a hernia in the linea semilunaris and it should be classified as ventral hernia. It was first described as ventroinguinal hernia by Monro. Scarpa adopted a similar classification which has since been advocated by Macready, Eccles and others.

Clinical Varieties of Direct Hernia.—Finochietto divided direct hernias into three varieties, the saccular, lipomatous, and splanchnic or visceral. 1.

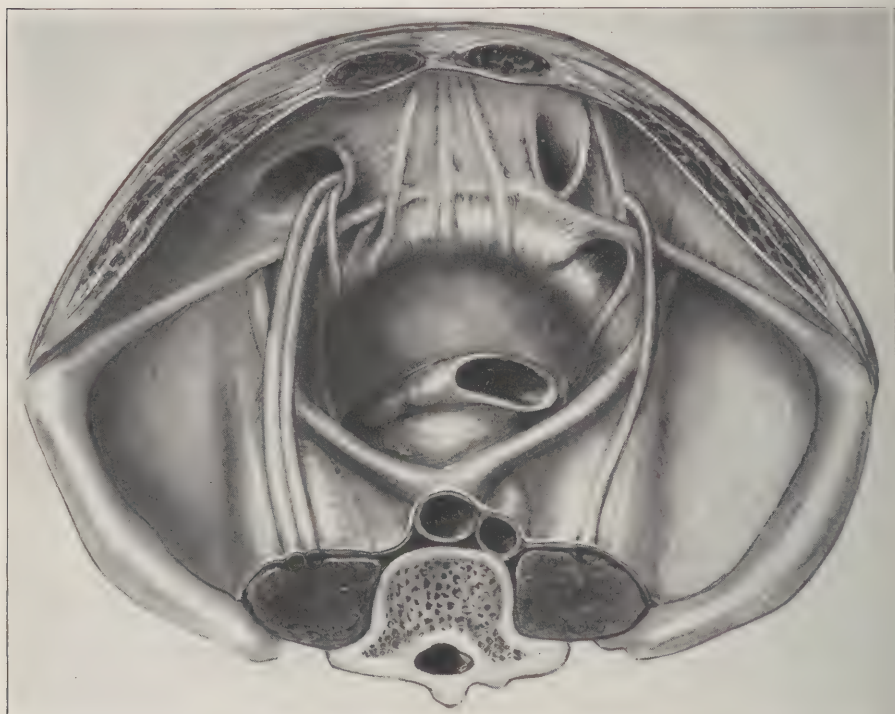


Fig. 37.—The internal openings of direct and oblique inguinal hernia and femoral hernia. (Redrawn from Wullstein.)

The saccular type, in which the tumor is hemispherical in shape, and dense transversalis fascia and properitoneum are found at the base of an empty peritoneal sac. He found this variety in 73 per cent of the cases. 2. The lipomatous sac type, which is usually a small hernia, with a thin layer of peritoneum covered by a very thick layer of fat. This variety occurred in 20 per cent of the cases. 3. The splanchnic or visceral type, in which viscera is always found in the sac, usually the bladder. This variety occurred in 6 per cent of the cases. In some instances the hernia begins as a lipoma, and as it increases in size the fat disappears (saccular type) and finally viscera

enter the sac; or, the saecular or splanchnic varieties may be present from the onset.

Direct Inguinal Hernia in Women.—Direct inguinal hernia is less common in women than in men, because in women the shape and formation of the inguinal canal are different, the external ring is smaller, and the aponeurosis of the external oblique covering the inguinal canal is stronger.

Donati dissected 31 female and 21 male cadavers. He found that in females, the internal oblique muscle was better developed in front of the canal than in males, and the arching fibers were often reenforced by cross fibers, which were absent in the males. The linear interstices in the external oblique aponeurosis were larger in the males than in the females.

Congenital Inguinal Hernia with Anomaly of the Testis.—The most common types of congenital inguinal hernia with anomaly of the testis are as follows:

1. *Hernia with Ectopia of the Testis.*—The testis may be retained in the iliac fossa, in the inguinal canal, or in front of the latter, or after leaving the canal it may pass downward toward the genitocrural fold or toward the perineum. When the testis has not descended, the intestine enters the canal, encircles the misplaced testis and passes through the external inguinal ring into the scrotum. There is frequently a constriction at the external ring which divides the hernia into two portions, one being in the inguinal canal and one in the scrotum. This is the hour-glass or wallet hernia (*hernie en bissac*)—a rare variety.

2. *Hernia with Inversion of the Testis.*—The testis and cord are found behind the hernia, instead of in front of it.

3. *Hernia with Incomplete Descent of Testis.*—When the testis is just outside the external ring and a hernia occurs, it descends in front of the testis. The external ring is enlarged and the testis passes out and in. This is the hernia usually found in the newly born and infants.

Interparietal (Intraparietal, Interstitial) Hernia.—Interparietal hernia is almost always oblique and usually occurs in the male, as a result of an anomaly of the testis. Three varieties of interparietal hernia are commonly described: Properitoneal, interstitial and inguinoperitoneal. (Figs. 38, 39 and 40.) Jaboulay maintains that these hernias are separate and distinct. Interparietal hernias were described in 1835 by Dance, and Birkett urged the adoption of this term. The name *interstitial hernia* was first used by Goyrand in 1836, who wrote: "The viscera issued from the abdomen through the superior orifice of the inguinal canal or by an abnormal opening in the fascia superficialis; instead of passing through this canal to break through the external orifice, it lodges in the cavity which it dilates, and in the interstice of the abdominal wall."

1. *Properitoneal Hernia.*—In properitoneal hernia the sac burrows between the peritoneum and the transversalis fascia. In 1839 Parise saw a case of hernia in which the sac was situated between the peritoneum and the trans-

versalis fascia, and in 1851 he described it under the name of intrailiac hernia. In 1861 Birkett proposed the term, intraparietal hernia, and Krönlein in 1876 gave it the name properitoneal hernia. This hernia is usually composed of two sacs which may be hour-glass shaped or bilocular. The inner or interparietal portion usually lies between the peritoneum and transversalis fascia, and as a rule, is directed toward the anterior superior spine of the ilium (13 out of 24 cases, Krönlein). Sometimes it extends downward toward the bladder (vesical variety), and rarely toward the obturator foramen (obturator variety). The properitoneal sac may sometimes become quite large. The outer portion, which is often empty, may be in the inguinal canal or very infrequently in the femoral canal or between the layers of the abdominal wall, as in the interstitial or inguinoperitoneal types.

All of these hernias that have bilocular sacs communicate with the abdomen by a common opening. The external inguinal ring may be normal or even dilated, especially when there is a loculus in the scrotum (Moynihan);

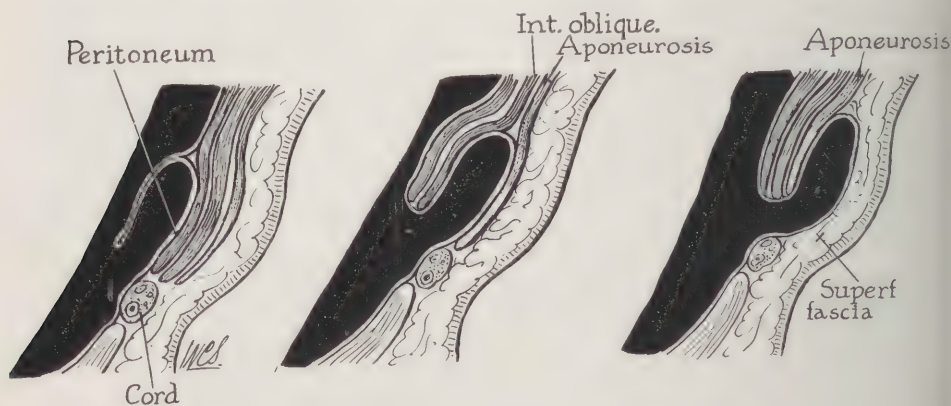


Fig. 38.

Fig. 39.

Fig. 40.

Interparietal (intraparietal, interstitial) hernia.

Fig. 38.—Properitoneal hernia. The sac lies between the peritoneum and the transversalis fascia.

Fig. 39.—Interstitial or intermuscular hernia. The sac burrows between the muscles of the abdominal wall.

Fig. 40.—Superficial inguinal hernia. The sac lies between the external oblique aponeurosis and the skin.

or it may be absent, as in the cases reported by Butz and Bramann; or it may be so small as to admit only a nerve, as in the case observed by Tillaux.

2. *Interstitial (Intermuscular) Hernia.*—In interstitial hernia the sac burrows (a) between the transversalis muscle and fascia; (b) between the fibers of the internal oblique muscle; (c) between the internal and external oblique muscles; (d) between the transversalis fascia and the external oblique muscle or aponeurosis (true interstitial hernia).

Interstitial Hernia in Women.—Interstitial inguinal hernias in women were described by Berger in 1891, and by Auvray in 1900. The hernia may be entirely between the layers of the abdominal wall (17 cases collected by

Auvray); or it may be bilocular, with the outer loculus prolonged into the labium majus.

There is more of a tendency for this hernia to extend toward the anterior superior spine in women than in men. Golding-Bird observed a case in a woman in whom the hernia had perforated the aponeurosis of the external oblique. Langton collected from the literature 50,000 cases of inguinal hernias in males, and found records of only 42 cases of interstitial hernias. Elsborg saw a woman with a bilocular interstitial hernia the size of a child's head; the lower loculus contained intestine and the upper one contained a large ovarian cyst. The neck of the bilocular sac was only one inch (2.5 cm.) in diameter.

3. *Inguinosuperficial hernia* (*Subcutaneous inguinal hernia*; *Superficial inguinal hernia*; *Prefascial hernia*; *Preaponeurotic interstitial hernia* [Eccles]; *Incomplete inguinal hernia* [Velpeau]; *Intrainguinal hernia* [Boyer]; *Hernia of Goyrand*).—In inguinosuperficial hernia the sac lies between the external oblique aponeurosis and the skin. Inguinosuperficial hernia was described by Le Fort in 1886, and later by Küster. In 1903 Moscheowitz was able to collect 17 cases from the literature. This form of interstitial hernia is situated between the skin and the external oblique aponeurosis. After passing through the external ring the sac rests in the subcutaneous tissues above it, most frequently extending in the direction of the anterior superior spine. Broca has seen it extend nearly to the umbilicus, and I have seen a loculus of the sac descend into the femoral region.

Inguinosuperficial hernia is almost always associated with undescended or maldescended testis; however, occasionally the testis is found in its normal position at the bottom of the scrotum. This hernia, which is probably due to a patent congenital diverticulum, presents the signs of a soft fluctuating tumor in the groin, and the testis can almost always be detected in the mass. The condition is much more frequent than is generally supposed.

Küster has observed a strangulation in superficial inguinal hernia which was produced by the external pillar of the abdominal ring at the point where the sac bends upward.

Undescended or Maldescended Testis in Interparietal Hernia.—Undescended or maldescended testis is generally associated with interparietal hernia in the male. The testis is often retained in the inguinal canal where it is only slightly movable, and causes a bulging in the sac. When it descends beyond the external ring, it is usually arrested at a point just below this opening; in fact, it is found in the upper part of the scrotum only in those cases in which the outer loculus projects toward the scrotum. The ectopic testis is often in the abdominal cavity. Curl saw a rare case of double inguinosuperficial hernia and double undescended testicle in a man aged 30. The testicles were brought down into the scrotum and the hernias repaired.

Supravesical Direct Hernias.—Supravesical direct hernias were described by Reich in 1909, and were divided into two groups, as follows:

1. *Internal supravesical hernia*, which is properitoneal, is located near the bladder.

2. *External supravesical hernia* may appear at either of the following points: (a) Between the conjoined tendon and the aponeurosis of the external oblique; (b) subcutaneously, in front of the aponeurosis of the external oblique. Reich collected 16 cases of the internal variety and 26 cases of the external variety from the literature. (See chapter on lateral ventral hernia.)

Inguinal Hernia and Cyst of the Cord.—The processus vaginalis may become obliterated at any point below the internal ring, and remain open farther down. These persistent enclosed portions are liable to become the sites of cysts, which develop when an accumulation of serous fluid has formed.

Cysts Connected with Hernial Sacs.—Cysts connected with hernial sacs are due to anomalies in the obliteration of the processus vaginalis. A great variety of these cysts have been described, and they are sometimes incorrectly called *hydroceles of the cord*. I agree with Murray and Lockwood, that they are due to a duplication of the processus vaginalis in which a second sac is drawn by additional fibers of the gubernaculum testis.

Hydrocele Associated with Hernia.—Hydrocele is due to an incomplete obliteration of the processus vaginalis and is often associated with hernia. The hydrocele may assume a variety of forms and it may be situated in any position in relation to the hernia—above it, in front or behind it, on one or both sides of it, or the hydrocele may entirely surround the hernia.

A hydrocele may have one or several loculi in the scrotum and in the inguinal canal. Sometimes a portion of the sac, large enough to hold all of the fluid in the loculi of the scrotal portion, is in the abdominal cavity. I recently operated on a patient in whom the abdominal loculus held the contents of three scrotal loculi, amounting to two quarts (2 liters) of fluid.

Lipomata in the Inguinal Canal.—Lipomata are frequently found in the inguinal canal along the cord. Their lower portion is usually attached to the sac, and their upper portion is continuous with the properitoneal fat at the internal ring. (See chapter on fatty hernia.)

The Sac.—The portion of the sac that lies in the internal ring is known as the mouth of the sac; on account of the constriction of the ring, the sac at this point lies in folds. The neck of the sac is the portion in the inguinal canal; it lies smoothly, held by the confines of the walls of the canal. The fundus or body of the sac lies beyond the external ring; it is usually oval or oblong in shape, and its walls may be considerably thickened due to the long-continued intraabdominal pressure and to the sagging weight of the contents, and to the external irritation of clothes, trauma and truss. The peritoneal sac is usually freely movable. Ball found that when operating for double hernia, torsion of one sac markedly diminished the size of the hernia on the opposite side.

Contents of the Sac in Inguinal Hernia.—In adults, a majority of inguinal hernias contain omentum, sometimes small intestine, rarely large intestine or other abdominal viscera. Every abdominal viscus has been found in the sac of inguinal hernia.

1. *Omentum and Small Intestine.*—The omentum descends into the sac first. As the hernia enlarges, the small intestine descends and lies behind the omentum—their relative position being the same as in the abdominal cavity. As pointed out by Dionis, omental hernias are more frequent on the right side because the omentum extends lower on this side.

Of the small intestine, the ileum is found much more frequently than the jejunum.

2. *The Large Intestine.*—The large intestine is alone in the sac only in rare instances. As a rule it follows the omentum and small intestine in their descent into the sac.

In old, massive, irreducible hernias the entire small intestine and large intestine may be found in the sac. In 800 cases of hernia of the large intestine that I collected from the literature, the different portions of the large intestine entered the sac in the following order of frequency: Cecum, sigmoid, ascending colon, descending colon, and transverse colon.

3. *The Stomach.*—Inguinal hernia of the stomach is very rare. In nearly all of the twenty cases I have collected from the literature, only a portion of the stomach was found in the sac.

4. *Kidney and Ureter.*—Inguinal hernia of the kidney is very rare. In four cases reported in the literature, the hernia was unilateral, and the right kidney was the one herniated.

(A number of cases of hernia of the ureter are on record, and are considered in the chapter on hernia of the ureter.)

5. *Ovary, Tube, and Uterus.*—The ovary and tube are sometimes found in inguinal hernia. As a rule, they are congenital in origin. (Hernia of the uterus is rare and is considered with hernia of the ovary and tube in a subsequent chapter.)

6. *The Bladder.*—A portion of the bladder is found in about 1 per cent of all inguinal hernias. The prostate is very rarely found in an inguinal hernial sac. (These are dealt with in the chapter on hernia of the bladder.)

7. *Other Hernial Contents.*—Other hernial contents sometimes found in inguinal hernial sacs are: Detached and hardened appendices epiploicae and pieces of omentum, and foreign bodies, such as pins, tacks, nails, and pieces of metal, wood or bone.

Disease of the Hernial Contents.—Among the lesions sometimes found in the hernial contents may be mentioned lipomas adherent to the cord or sac, epiploitis, suppuration of the hernial contents, drainage of appendiceal

or other abscesses into the hernial sac, tuberculosis of the sac or contents, cysts, and benign and malignant growths.

Intrasaccular Adhesions.—Omental adhesions are very rare in children, but are almost always found in adult hernias.

Bibliography

INGUINAL HERNIA—ANATOMY

- ADAMS, J. E.: Case of inguino-femoral hernia. *Med. Press and Circ.*, Lond., 1912, n. s. xciv, 359-360.
- AUVRAY, M.: Hernie inguino-interstitielle chez la femme (Hernie de Goyrand). *Gaz. hebdom. de méd.*, Par., 1900, xlvii, 542-547.
- BALL, C. B.: The radical cure of hernia by torsion of the sac. *Brit. M. J.*, Lond., 1884, ii, 461-462.
- BERGER, P.: Sur quelques variétés de la hernie inguinale congénitale chez la femme: en particulier des hernies compliquées d'un kyste du canal de Nuck et des hernies en bissac. *Bull. et mém. Soc. de chir. de Par.*, 1891, xvii, 283-294.
- BIANCHETTI, C. F.: Considerazioni sopra un caso di ernia inguinale obliqua interna nella donna. *Polichin. Roma*, 1921, xxviii, sez. chir., 309-317.
- BIRKETT, J.: Hernia. In: *Holmes' system of surgery*. 2nd ed. New York, Wood & Co., 1870, iv, 706.
- BLAKE, J. A.: The relative bearing of the conjoined tendon and the internal oblique muscle upon the radical cure of inguinal hernia. *Med. Rec. N. Y.*, 1900, lviii, 321-324.
- BOYER, A.: *Traité des maladies chirurgicales*, Paris. Migneret, 1822, viii, 227.
- BRAMANN, F.: Der Processus vaginalis und sein Verhalten bei Störungen des Descensus testiculorum. *Arch. f. klin. chir.*, Berl., 1890, xl, 137-168.
- BROCA, A.: Hernie inguino-interstitielle. *Bull. Soc. Anat. de Par.*, 1888, lxiii, 111-125.
- BUTZ, R. V.: [On inguino-properitoneal hernia]. *Chir. Vestnik, St. Petersburg*, 1888, iv, 419-442.
- CAMPER, P.: *Sämmtliche Kleinere Schriften*, Leipzig, S. L. Crusius, 1785, ii, 50.
- CLARAC, E.: Contribution à l'étude de la hernie enkystée d'Astley Cooper. Thèse, Lyon, 1895.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.
- CORLETTE, C. E.: Two direct inguinal hernias on the same side. *Australas. M. Gaz.*, Sydney, 1914, xxxv, 458.
- CURL, H. C.: Bilateral inguino-superficial hernia with bilateral undescended testicle. *U. S. Naval M. Bull.*, 1911, v, 51.
- DANCE, C.: De la hernie intra-pariétale, Thèse, Paris, 1835.
- DIONIS, P.: The anatomy of the humane bodies. English trans. from the 3rd French ed., London, H. Bonwicke, 1703, p. 118.
- DONATI, M.: Sull' ernia inguinale diretta nella donna; contributo clinico e ricerche anatomiche intorno alle formazioni limitanti il canale inguinale nei due sessi. *Arch. per le sc. med.*, Torino, 1905, xxix, 203-232.
- ECCLES, W. M.: *Hernia*. 3rd ed., New York, W. Wood & Co., 1908.
- ECCLES, W. M.: A case of right interstitial inguinal hernia. *West Lond. M. J.*, Lond., 1917, xxii, 72.
- ELSBERG, C. A.: Inguinal interstitial hernia in a woman; ovarian cyst in hernia. *Med. Rec.*, N. Y., 1902, lxii, 875.
- FAUNTLEROY, A. M.: Development of an inguinal hernia through the femoral ring following descent of the testicle by the same route. *Ann. Surg.*, Phila., 1920, lxxii, 675.
- FÉRÉ, C.: Études sur les orifices herniaires et sur les hernies abdominales des nouveau-nés et des infants à la mamelle. *Rev. mens. de méd. et chir.*, Paris, 1879, iii, 551.
- FINOCHIETTO, R.: Pathological findings in retro-inguinal hernias. *Surg. Gynec. & Obst.*, Chi., 1916, xxii, 554-556.
- GOLDING-BIRD, C. H.: Two cases of "Hernie en bissac" in women, one being also "Intraparietal." *Tr. Clin. Soc.*, Lond., 1884, xvii, 210-213.
- GOYRAND, G.: De la hernie inguino-interstitielle. *Mém. Acad. de méd.*, Par., 1836, v, 14-30.

- HENLE: See Jaboulay, M. et Patel, M.: p. 145.
- HERTZLER, A. E.: Treatment of inguinal hernia in children. *J. Am. M. Assn.*, Chi., 1913, lxi, 1879-1882.
- HESSELBACH, F. C.: Neueste anatomisch-pathologische Untersuchungen über den Ursprung und das Fortschreiten der Leisten- und Schenkelbrüche. Würzburg, J. Stabel, 1814.
- HEY, W.: Practical observations in surgery. Phila., J. Humphries, 1805, 144-147.
- HUNTER, J.: On the descent of the testis—medical commentaries, by W. Hunter, 1762, part 1, p. 75.
- JABOULAY, M.: La hernie à double sac. *Lyon méd.*, 1896, lxxxiii, 10-12.
- JABOULAY, M., AND PATEL, M.: Hernies. xxv *Nouveau traité de chirurgie*, Le Dentu, A., et Delbet, P., Paris, Baillière, 1908.
- JARJAVAY: Remarques sur les hernies. *Gaz. d. hôp.*, Par., 1860, xxxiii, 385-387; 401.
- KAISER, F.: Ueber Hernia encystica. *Beit. z. klin. Chir.*, Tübing., 1920, cxviii, 306-317.
- KEITH, A.: Surgical applied anatomy. (Treves, F., 6th ed. revised by A. Keith) Lond., Cassell, 1911.
- KÖLLIKER, T.: Ueber die Hernia processus vaginalis encystica. *Centralbl. f. Chir. Leipz.*, 1887, xiv, 973-974.
- KRÖNLEIN, R. U.: Hernia inguino-properitonealis incarcerationata. *Arch. f. klin. Chir.*, Berl., 1876, xix, 408-420.
- KURTZHALSS, H.: Ueber die Hernia processus vaginalis encystica. I. D., Leipz., 1918.
- KÜSTER, E.: Beiträge zur Lehre von den Hernien. *Arch. f. klin. Chir.*, Berl., 1886-1887, xxxiv, 202-221.
- LANGTON, J.: The association of inguinal hernia with the descent of the testis. Bradshaw lecture Royal College of Surgeons, *Lancet*, Lond., 1900, ii, 1857-1864.
- LE CAT: Another sort of duplicity of the herniary sack. *Ph. Tr.*, Lond., 1751-52, xlvii, 326-327.
- LE FORT, L.: Sur un cas rare de hernie inguinale qu'on pourrait appeler pré-inguinale. *Bull. gén. de Therap.* [etc.], Par., 1886, ex, 49-55.
- LOCKWOOD, C. B.: Hunterian lectures on the morbid anatomy, pathology, and treatment of hernia. London, H. K. Lewis, 1889.
- MACAGGI, G. B.: Sui rapporti dell'ernia inguinale diretta coi vasi epigastrici profondi. *Policlin.*, Roma, 1921, xxviii, sez. chir., 56-62.
- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- MALGAIGNE, J.: Leçons cliniques sur les hernies. Paris, Germer-Baillière, 1841.
- MÉRY, J.: Sur les hernies. *Mém. Acad. roy. d. sc.*, de Par., 1701, p. 273.
- MONOD, C.: Note sur une variété de hernie intra-vaginale (hernie enkystée d' A. Cooper, hernie à double sac, à sac intra-vaginal de Bourgnet.) *Bull. et mém. Soc. de chir.* de Par., 1883, n. s. ix, 210-214.
- MONRO, A.: The morbid anatomy of the human gullet, stomach and intestines. Edinburgh, Ramsay & Co., 1811.
- MORTON, T.: The surgical anatomy of inguinal herniæ, the testis and its coverings. London, Taylor & Walton, 1841.
- MOSCHCOWITZ, A. V.: Inguino-superficial hernia (Kuester). *Med. Rec.*, N. Y., 1903, lxiii, 52-55.
- MOYNIHAN, B. G. A.: The anatomy and pathology of the rarer forms of hernia. The Arris and Gale lectures, R. C. S., 1900. *Brit. M. J. Lond.*, 1900, i, 435-440.
- MURRAY, R. W.: Hernia. 2nd ed. Phila., Blakiston, 1910.
- MURRAY, R. W.: The etiology of cysts connected with hernial sacs. *Ann. Surg.*, Phila., 1916, lxiii, 544-547.
- NICK, A.: Adenographiam curiosam. *Lugduni*, J. Luchtman, 1696, p. 135-138.
- PARISE, J.: Mémoire sur deux variétés nouvelles de hernies, la hernie inguinale intra-iliaque et la hernie inguinale antévesicale. *Mém. Soc. de chir. de Par.*, 1851, ii, 399-430.
- PETIT, J. L.: See Méry, J.: p. 273.
- PIERSOL, G. A.: Human Anatomy. 6th ed., Phila., Lippincott, 1918, p. 2040-2042.
- RAMONÉDE, L.: Le canal péritonéo-vaginale et la hernie péritonéo-vaginale étranglée chez l'adulte. Thèse, Paris, 1883.
- REICH, A.: Die intra-abdominalen Hernien der Foveae supravesicales: Herniæ supra-vesicales internæ. *Beitr. z. klin. chir. Tübing.*, 1909, lxii, 20-77.
- ROUSTAN: De quelques modes de guérisons naturelles des hernies. *J. de chir.*, (Malgaigne), Par., 1843, i, 298, 323.
- RUSSELL, R. H.: The etiology and treatment of inguinal hernia in the young. *Lancet*, Lond., 1899, ii, 1353-1358.
- RUSSELL, R. H.: The morbid anatomy and pathology of infantile and encysted hernia with a note on accident of taxis. *Brit. M. J.*, Lond., 1907, ii, 1392-1395.

- RUSSELL, R. H.: Inguinal herniæ; their varieties, mode of origin, and classification. Brit. J. S., Bristol, 1922, ix, 502-508.
- SACHS, H.: Untersuchungen über den Processus vaginalis peritonei als prädisponirendes Moment für die äussere Leistenhernie. Arch. f. klin. Chir., Berl., 1887, xxxv, 322-372.
- SCARPA, A.: Sull'ernie memorie anatomico-chirurgiche. 2nd ed., Dalla stamperia Fusi e co., success. Galeazzi, Pavia, 1819.
- SPALTEHOLZ, W.: Handatlas Anatomie des Menschen, 5th ed., Leipz., S. Hirzel, 1907, ii, 280-282.
- TERRILLON, O.: Hernie enkystée congénitale dans une hydrocèle funiculaire également congénitale. Bull. et mém. Soc. de chir. de Par., 1892, xviii, 771-772.
- TILLIAUX, P.: De la hernie inguino-interstitielle; rôle du taxis dans cette hernie. Bull. gen. de Therap. etc., Par., 1871, lxxxi, 209-217.
- VELPEAU, A. A. L. M.: Operative surgery. English transl. by P. S. Townsend. New York, 1851, iii, 651.
- ZUCKERKANDL, E.: Ueber den Scheidenforsatz des Bauchfelles und dessen Beziehung zur äusseren Leistenhernie. Arch. f. klin. Chir., Berl., 1877, xx, 215-225.

CHAPTER X

ETIOLOGY OF INGUINAL HERNIA

Before the adoption of the saccular theory, oblique inguinal hernias were divided into the congenital and acquired varieties. The congenital form was believed to be limited to infants and children, and the acquired form to adults. It was thought that a peritoneal sac was forced through a weak point in the abdominal wall following a strain or trauma. The present opinion is that except for the rare cases of true traumatic hernia, all oblique inguinal hernias are congenital in origin, regardless of the age of the subject when the hernia first appears.

Congenital hernias are due to the persistence of a patent processus vaginalis, and a sudden strain or trauma merely forces the abdominal viscera into a congenital preformed sac. There are two distinct varieties of congenital hernial sacs:

1. The complete sac, which is continuous with the tunica vaginalis. This is the infrequent variety, occurring in only 10 per cent of infants and children.
2. The incomplete sac, which is entirely separate from the tunica vaginalis. This is the more common variety, both in children and adults.

The Descent of the Testis.—The descent of the testis, which is fully described in the chapter on anatomy, is an important factor in the cause of inguinal hernia, because an undescended testis is nearly always accompanied by an actual or potential hernial sac. I recently saw a boy, five years old, with a hernia and undescended testis of the right side, whose family history was of interest, in that both his father and paternal grandfather had had an undescended testis and hernia that persisted into adult life.

The Processus Vaginalis.—The processus vaginalis descends ahead of the testis and when obliteration fails to take place at birth, this canal becomes a potential hernial sac. The canal of Nuck in the female is analogous to the processus vaginalis testis in the male. When the processus vaginalis closes normally, it is converted into a white fibrous cord which is easily recognizable during dissection or operation.

It is generally agreed that all oblique inguinal hernias are of congenital origin. When obliteration is incomplete, fibrous bands may form anywhere in the funicular process. I have seen one of these constrictions that was responsible for strangulation, in the lower part of the scrotum.

Potential Hernia.—The presence of empty congenital sacs in adults is more common than is generally supposed. Many people carry these potential hernial sacs throughout life without evidence of hernia.

In the postmortem examination of one hundred subjects that presented no evidence of hernia during life, Murray found sacs in 21; in several of these there was more than one sac. In another series of 200 examinations, Raw and Murray found 68 peritoneal diverticula, and of these 52 were femoral, 13 inguinal, and 3 umbilical. Murray believed that when a patent funicular process exists, the occurrence of a hernia depends on the size of the opening at the internal abdominal ring and the strength of the muscles that protect this orifice. He also stated that when the processus vaginalis has been completely obliterated, it is impossible for an oblique inguinal hernia to occur.

Hernias are most likely to come down into preformed sacs following the activities of youth, the laborious occupations of adult life, and the strain of repeated pregnancies. Emaciation, due to disease or old age, may also be a factor by removing the fatty plugs that have kept the patent funicular process temporarily closed. Owing to the lack of food during the great War, there was an increase of 25 per cent of hernia in Germany alone.

It is not unusual to see an oblique inguinal hernia develop on the sound side, after one on the opposite side has been reduced and retained by a truss or cured by operation. This second hernia is probably due to an increase in intraabdominal tension. I often advocate a bilateral operation for inguinal hernia, especially in young adults. In 50 operations for unilateral hernia, I found a potential sac on the opposite side in 22 cases. I have used this combined operation a number of times, and occasionally have been surprised to find a larger sac on the sound side than on the affected side. I believe it is always advisable to operate on the sound side when there is an enlarged ring, or an exaggerated impulse.

Anatomic Causes of Oblique Inguinal Hernia.—The anatomic factors that favor the development of oblique inguinal hernia may be summarized as follows: (a) The descent of the testis which carries with it a process of peritoneum, transversalis fascia (infundibuliform fascia), and cremaster muscle; (b) the weak spot at the internal ring, caused by the pouching of the peritoneum; (c) the location of the internal ring, which makes it unable to resist sudden increase in intraabdominal pressure caused by straining, coughing, whooping cough, pregnancy, tight lacing, obesity, ascites and tumors; (d) the hernia cannot break through outside the internal ring because of the well-developed iliac and transversalis fascia; (e) the fact that there is usually a weak point near the inner side of the internal ring that is unprotected by muscle or tendon; (f) the existence of an unobliterated processus vaginalis or a preformed sac.

Hernia Following Hydrocele Operation.—When a large tense hydrocele extends into the inguinal canal, it weakens the internal ring and destroys the obliquity of the inguinal canal. Unless a herniorrhaphy is done at the time of the hydrocele operation, a hernia usually develops in a few weeks or months.

Patent Processus Vaginalis and Undescended Testis.—Undescended testis is nearly always associated with a patent processus vaginalis—a potential hernia sac.

Military Training and Oblique Inguinal Hernia.—During the great War many recruits who were called from sedentary occupations to military service developed hernias under intensive training. It is an interesting point, and one that lends weight to the saccular theory, that most of these hernias appeared during the early period of training. If the muscles could withstand the strenuous unaccustomed exercise for the first few weeks, the added resistance that comes from such training made the later appearance of hernia infrequent.

Acute Onset of Congenital Hernia in Soldiers.—There was a high percentage of *acute* hernias that occurred during the great War. There was usually a history of sudden onset, and operation disclosed a well-developed sac, often containing a small amount of fluid. It is probable, in these cases, that only partial obliteration of the processus vaginalis had taken place, and this had been limited to the upper end near the internal ring.

Inguinal Hernia in the Female.—Inguinal hernia constitutes about 45 per cent of all hernias occurring in females. Macready estimated the frequency at 60 per cent. These hernias are almost always of the external oblique variety and are of congenital origin, being due to an unobliterated process of peritoneum, known as the canal of Nuck, which is analogous to the processus vaginalis testis. Obliteration of this peritoneal diverticulum occurs with greater frequency in the female than in the male. Nobbe stated that the canal of Nuck is found in 8 to 10 per cent of female subjects, and a patent processus vaginalis testis is present in 30 to 40 per cent of male subjects.

The Inguinal Fossae.—The importance of the funnel-like depressions of the inguinal fossae as a cause of direct hernia has been pointed out by Joessel, Tillaux, Waldeyer, and Tinker. According to Tinker, the depth of the fossae varies considerably, often being well marked when a hernia is present. In one dissection Tinker found the internal inguinal fossa over $1\frac{1}{2}$ inches (3 cm.) deep.

Deficiency of the Conjoined Tendon.—Absence or weakness of the conjoined tendon may be an important factor in the causation of direct hernia, and of less importance in the etiology of oblique hernia.

Deficiency of the Internal Oblique and Transversalis Muscles.—Ferguson observed that during operations for oblique inguinal hernia, there is frequently a deficiency of the internal oblique and transversalis muscles at their origin from Poupart's ligament, and he concluded that the faulty development of these muscles weakens the internal ring, and is the most common cause of oblique inguinal hernia.

Fat.—An accumulation of fat in the abdominal wall predisposes to hernia by weakening the muscles and relaxing the rings, while the fatty infiltration of the omentum and mesentery increases intraabdominal tension.

Lipoma in the Inguinal Canal.—A lipoma in the inguinal canal that is adherent to the sac or cord is almost always attached to the properitoneal fat at the internal ring, and by causing a bulging into the canal, favors the development of hernia. The lipomata should always be removed at operation to lessen the danger of recurrence. In 154 hernia operations, Speed found lipomata in 47.4 per cent.

Predisposing Causes.—There are several factors that may favor the production of oblique and direct inguinal hernia:

1. *Heredity.*—The influence of heredity as a cause of inguinal hernia is uncertain. Cooper believed that the shape of the pelvis plays some part. Macready said that hernia occurs more frequently in subjects whose parents had hernias than in those whose parents were sound. It is probable, however, that an inherited weakness of the abdominal muscles is just as much of an influence as the existence of hernia in one or both parents.

2. *Sex.*—Inguinal hernia is very much more common in males than in females. Ninety-five per cent of all hernias in males are of the inguinal type, while in females only 45 per cent are inguinal. The greater prevalence in the male is partly due to the size of the spermatic cord, which is much larger than the round ligament, and the processus vaginalis testis is less frequently obliterated than the canal of Nuck. Macready found that 97.5 per cent of all hernias in men, and 60.3 per cent of all hernias in women, are inguinal.

3. *Age.*—Macready also stated that in the first year of life a larger number of persons are living, consequently there are more hernias than in any subsequent year. In the first year, 17.5 per cent of males have hernia, and 9.16 per cent of females.

The number of hernias in children and adults is highest during the years of greatest activity. The tendency to hernia increases with age, but the exciting causes are less active. After fifty years, the reduction in the number of hernias in women is much greater than in men.

Frequency of Right and Left Hernias.—The greater frequency of right hernia in the first year, and the high proportion until after puberty is due to delayed descent of the testis and to the later closure of the canal on the right side. After the age of 20, hernias occur on the left side nearly as frequently as on the right side.

Velpeau, and more recently Lockwood, explained the greater frequency of right inguinal hernia by the inclination of the mesentery toward the right iliac fossa. Cooper thought it was due to the greater exertions made by the right side; while Knox attributed it to the greater capacity of the right side of the pelvis, as compared with the left side. These theories are of little more than historic interest, because no doubt the true cause lies in the slower

closure of the processus vaginalis or the canal of Nuck on the right side. Direct hernia appears most often on the right side.

Traumatic Direct Hernia.—Any operative procedure in the inguinal region may be followed by a hernia, usually of the direct variety, if the original incision lies internal to the deep epigastric artery. Hernia sometimes follows the operation for shortening the round ligaments, and the inguinal operation for femoral hernia.

Exciting Causes.—The exciting causes of inguinal hernia are those common to all hernias, and are more fully described in the chapter on general considerations. Among them may be mentioned the following: Injury; constipation; strains, such as lifting a weight; coughing, as in bronchitis or whooping cough; ascites; urethral obstructions and possibly phimosis; a gradual increase in intraabdominal pressure, due in infants to a tight umbilical binder or in adults to a tight belt; and any factor that produces a sudden increase in intraabdominal tension. Trick believed the most potent force in the production of hernia is increased intravisceral pressure exerted from within outward, and caused by the concentric compression of the abdominal muscles; I believe that there must first be a preformed sac before this cause can be an active factor.

Artificial Hernia.—Artificial hernias are produced by dilating forcibly the external and internal rings with the finger or with a blunt stick or similar instrument, sometimes aided by light blows from a hammer or mallet. It is very painful, and often the patient faints during the ordeal. To bring the hernia down, after the inguinal ring is dilated, the patient takes an emetic to induce retching and vomiting, and sometimes snuff to produce sneezing. The hernia usually appears in one to three days. Artificial hernias are induced for the purpose of escaping military duty; the custom is most common in Russia, but is practiced also in other countries.

Right Inguinal Hernia Following Operation for Appendicitis.—Inguinal hernia follows the operation for appendicitis more often than is generally supposed, and is due to the division of the nerve supply of the muscles in the region of the internal ring, usually the iliohypogastric nerve, and sometimes the twelfth dorsal or ilioinguinal nerve.

Hernia may also occur following the destruction of nerves, fascia or muscles, by suppuration or by pressure from gauze or tube drains. I have seen inguinal hernia follow the McBurney or muscle-splitting operation, and also the lateral rectus incision. It is much more frequent after the McBurney incision.

Hoguet, in an important paper on this subject, reported 190 operations for appendicitis with inguinal hernia following in 8 cases, and Hare has reported 3 cases. Griffiths reported 11 cases; 10 of these followed the McBurney incision.

A ventral hernia in the scar of the appendix incision may complicate the inguinal hernia: I recall one patient whom I first saw three months

after his operation for appendicitis through the McBurney incision. At this time he had a large unruptured abscess in the appendix region and a small right inguinal hernia of 2 months' duration. I operated on the hernia, and after opening the sac, introduced my finger into the abdomen and easily palpated the appendix abscess, two inches (5 cm.) above the internal ring. The hernia incision healed by primary union, and a week later I opened the appendix abscess and removed the silk sutures which had been used by the first operator, and were probably responsible for the suppuration. In another patient, an oblique inguinal hernia appeared six months after an operation for appendicitis in which a short lateral rectus incision was used. No



Fig. 41.—Right inguinal hernia that appeared two months after operation for appendicitis. There is a large abscess at the site of the appendix incision.

drainage was employed and the wound healed by primary union. The hernia probably was due to the severing of the iliohypogastric nerve. (Fig. 41.)

Double Hernia.—Macready stated that in bilateral oblique inguinal hernia, the hernias occur simultaneously in 4.6 per cent of the males and in 3.1 per cent of the females; of these, 48.9 per cent in females appear in the first year of life. As life advances many single hernias become double; 36.6 per cent in males and 23.3 per cent in females. On the other hand, double femoral hernia is more common in females. The proportion of double inguinal hernias to the single hernias is .64 per cent to 1 per cent.

The Cause of Interparietal Hernias.—Interparietal hernias, which include the properitoneal, interstitial, and inguinoperitoneal varieties, nearly always occur in males and are generally associated with undescended, imperfectly

descended or malformed testes. Henru, in 1802, believed the properitoneal sac was the result of repeated reductions of hernia with a narrow neck.

Later, Tillaux advanced the following explanation, which was generally accepted as the cause of interparietal hernias until the introduction of Russell's saccular theory: The intestine enters the inguinal canal through the patent processus vaginalis, but is arrested at the external ring. Effort and intraabdominal pressure cause new loops to enter the sac. The inguinal canal dilates behind the constricted external ring and the hernia enlarges in the direction of least resistance, which is upward toward the umbilicus.

Maeready believed that the partially descended testis prevents the hernia from entering the scrotum, and it follows the line of least resistance, passing upward between the layers of the abdominal wall. He thought that in the female, hydrocele in the canal of Nuck acts as an obstruction, causing the hernial sac to be diverted upwards. However plausible these explanations may be, they were discarded with the advent of the saccular theory.

Preformed Sac or Congenital Malformation.—At the present time, it is generally believed that interparietal hernias are due to the existence of a preformed congenital peritoneal diverticulum, often associated with developmental anomalies of the inguinal canal. (See section on preformed sacs in chapter on anatomy.)

The Cause of Bilocular Sacs in Interparietal Hernia.—The sac in properitoneal hernia is nearly always bilocular; in the interstitial and inguino-superficial varieties, it may have two loculi, but there is usually only one.

Properitoneal Hernias.—A number of theories have been proposed to explain the development of properitoneal hernias. They are probably always congenital in origin and the bilocular sacs are due to congenital diverticula. The hernia may appear at any time following a strain. In aged subjects the diverticula are sometimes found empty and collapsed.

Gosselin, Streubel, and Krönlein believed that a portion of the neck of the sac dilates after being forced back into the abdominal cavity. This condition might be produced by taxis, pressure of a truss, ectopic testis, tumor of the round ligament, or a constriction in the processus vaginalis; Janzer thought that it might be due to the traction of omental adhesions within the sac; and Schmidt believed that as the internal ring enlarges, the upper part of the processus vaginalis becomes distended, forming the properitoneal sac.

Frequency of Interparietal Hernias.—While it is generally agreed that interparietal hernias occur more frequently in males, Langton stated that they are twice as frequent in women as in men, and he gave multiple pregnancies and lax abdominal walls as the principal predisposing factors.

Inguinoperineal Hernia.—Inguinoperineal hernia is of congenital origin and is usually associated with maldescended testis. It is due to the development of the perineal portion of the gubernaculum which causes the testis, accompanied by its processus vaginalis testis, to descend into the perineum

instead of into the scrotum. This variety of maldescended testis is more frequent than the crural or pubopenile varieties.

Direct Inguinal Hernia.—Direct inguinal hernia occurs most often in men between the ages of 40 and 50 years. It is very rare in children. In 430 operations for inguinal hernia in children reported by Andrei, there were 2 cases of the direct variety. It is more often bilateral than the oblique. Murray stated that 55 per cent of these hernias are bilateral. Finochietto believed that 10.3 per cent of all inguinal hernias treated by operation are direct.

Direct inguinal hernia is acquired, being due to the same causes that produce hernia in the linea semilunaris; as a matter of fact, direct hernia



Fig. 42.—Right direct inguinal hernia of two years' duration. There is an oval or globular swelling opposite the external ring. This variety of hernia seldom descends into the scrotum.

comes through the lowest part of the linea semilunaris, which is the weak spot in Hesselbach's triangle. For this reason, many writers consider direct inguinal hernia as a variety of hernia in the linea semilunaris. (Figs. 42, 43, and 44.)

Direct inguinal hernia was first described by Heister in 1724, and Camper dissected a case in 1759. In 1771 Monro saw a case and called it ventro-inguinal hernia. Scarpa also believed direct hernia was a combination of the inguinal and ventral varieties. Cooper, who saw 6 cases, called attention to the danger of severing the deep epigastric artery when relieving the constriction of strangulation. Hesselbach first wrote on inguinal hernia in 1806, and in 1814 his classic monograph appeared.

Frequency of Direct Inguinal Hernia.—Direct inguinal hernia is infrequent, constituting only about 5 to 7 per cent of all inguinal hernias. Some



Fig. 43.—The same patient. Note the absence of bulging over the inguinal canal and at the internal ring.



Fig. 44.—Bilateral direct inguinal hernia.

writers have placed the percentage much higher, notably, Wilkie, who, in 135 inguinal hernia operations on soldiers, found 93 oblique and 42 direct hernias.

Direct Hernia Following Operation for Oblique Inguinal and Femoral Hernia.—Direct hernia occasionally follows a successful operation for oblique inguinal hernia, and it occurs rarely, after an inguinal operation for femoral hernia. In these cases it is probable that a small congenital diverticulum existed and was overlooked at the first operation. The reduction of the first hernia, with the consequent increase in intraabdominal tension, along with the weakening and stretching of Hesselbach's triangle caused by the deep sutures, sometimes is sufficient to bring on a direct hernia.

I operated on a patient for oblique inguinal hernia by the Bassini method, and a year later he returned to me with a direct hernia on the same side, of



Fig. 45.—Direct inguinal hernia developing six months after operation for oblique inguinal hernia on the same side.

six months' standing. At operation I found the direct hernial sac was nearly two inches (5 cm.) long and was confined to Hesselbach's triangle. I carefully examined the oblique inguinal region, and noted that on the peritoneal side there was no relaxation or puckering of the peritoneum and the cord was tightly encircled by the internal ring. The internal oblique muscle and the conjoint tendon showed no evidence of atrophy, and were so firmly attached to Poupart's ligament that they could not be separated by blunt dissection, and it was necessary to use scissors to divide them before the deep sutures of the direct hernia operation could be placed. This case affords positive evidence that firm union takes place between the internal oblique, conjoint

tendon and Poupart's ligament, providing these structures are perfectly approximated by the deep sutures. (Fig. 45.)

Causes of Irreducibility.—The following changes are liable to occur in unreduced hernias: Adhesions form between the hernial contents and between the contents and the sac wall; the pressure of the neck of the sac causes the portion of the contents at that point to decrease in size; fat is deposited in the appendices epiploicae, and in the omentum and mesentery in the fundus of the sac, with the result that the hernial contents are larger than when they first came down; and an accumulation of intestinal contents, due to partial obstruction of the distal loop, may take place in the hernial sac. New growths, abscesses or tuberculosis of the hernial contents may also cause irreducibility.

Frequency of Irreducibility.—Irreducibility occurs most often in subjects between 30 and 60 years of age in both sexes. It is rare in children because their hernias are usually enteroceles (90 per cent). Less than 0.5 per cent of the hernias in males under 16 years of age are irreducible.

Irreducibility of Omentum.—On account of the early formation of adhesions, the omentum is not only the most difficult part of the hernia to reduce, but it is the usual cause of irreducibility (90 per cent).

Causes of Strangulation.—The points of strangulation in the order of their frequency are: (a) The edge of the internal ring; (b) the edge of the external ring; (c) in the inguinal canal, due to constriction by the fibers of the transversalis or internal oblique muscles; (d) in the neck of the sac, as a result of pathologic changes.

In direct inguinal hernia, strangulation is rare, but when it occurs it is usually at the external ring. Hemorrhage occurring within the intestine lying in the hernial sac, is one of the unusual causes of strangulation. McGirk reported a case of this kind in a man, aged 32, who noticed a sudden swelling in a previously reducible inguinal hernia. Five hours later it was tense, painful and irreducible. Operation disclosed gangrene involving 9 inches (22.5 cm.) of intestine.

Overdistention of the portion of the bladder lying in the hernial sac is sometimes a cause of partial strangulation. Niblock reported such a case in a patient who urinated while being prepared for operation and the "strangulated" hernia disappeared. At operation sometime later, a portion of the bladder was found in the sac.

Bibliography

INGUINAL HERNIA—ETIOLOGY

- ANDREI, G.: Contributo statistico alla cura radicale dell'ernia inguinale nei bambini, con speciale riguardo a quelle del cieco e dell'appendice. *Riforma med.*, Napoli, 1909, xxv, 763-770.
- CAMPER, P.: *Sämmtliche Kleinere Schriften*, Leipzig, S. L. Crusius, 1785, ii, 59.
- COOPER, A. P.: *The anatomy and surgical treatment of abdominal hernia*. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.

- FERGUSON, A. H.: Oblique inguinal hernia; typic operation for its radical cure. *J. Am. Med. Assn.*, Chi., 1899, xxxiii, 6-14.
- FINOCHIETTO, R.: Pathological findings in retro-inguinal hernias. *Surg. Gynec. & Obst.*, Chi., 1916; xxii, 554-556.
- GOSSELIN, L.: *Leçons sur les hernies abdominales*. Paris, Delahaye, 1865.
- GRIFFITHS, G. H. C. St. G.: The frequency of right inguinal hernia after appendectomy by the "gridiron" incision. *Lancet*, Lond., 1919, ii, 1026-1027.
- HARE, E. R.: A study of the abdominal wall in its relation to hernia. *Journal-Lancet*, St. Paul, 1916, xxxvi, 290-292.
- HEISTER, D. L.: See Camper, P.: p. 59.
- HENRU: See Macready, J. F. C. H.: p. 144.
- HELSELBACH, F. C.: *Neueste anatomisch-pathologische Untersuchungen über den Ursprung und das Fortschreiten der Leisten- u. Schenkelbrüche*, Würzburg, 1814.
- HOGUET, J. P.: Right inguinal hernia following appendectomy. *Ann. Surg.*, Phila., 1911, liv, 673-676.
- JANZER, J.: Innere Einklemmung nach gelungener Bruch taxis. *Aerztl. Mitth.* a. Baden, Karlsruhe, 1859, xviii, 105; 113.
- JOESSEL, G.: *Lehrbuch der topographisch-chirurgischen Anatomie*. ed. by W. Waldeyer, Bonn, F. Cohen, 1899, ii, 155-157.
- KNOX, R.: Observations on the statistics of hernia, and the anatomical causes which determine its production. *Edinb. M. & S. J.*, 1836, xvi, 76-89.
- KRÖNLEIN, R. U.: Hernia inguino-properitonealis incarcerata. *Arch. f. klin. Chir.*, Berl., 1876, xix, 408-427. Also: Über die Hernia inguino-properitonealis. *Arch. f. klin. Chir.*, Berl., 1880, xxv, 548-579; 1881, xxvi, 521-524.
- LANGTON, J.: The association of inguinal hernia with descent of the testis. Bradshaw lecture Royal College of Surgeons. *Lancet*, Lond., 1900, ii, 1857-1864.
- LOCKWOOD, C. B.: *Hunterian lectures on the morbid anatomy, pathology, and treatment of hernia*. London, H. K. Lewis, 1889.
- MACREADY, J. F. C. H.: *A treatise on ruptures*. Lond., C. Griffin & Co., 1893.
- MCGIRK, C. E.: Strangulated inguinal hernia due to hemorrhage of unknown origin within the intestine. *Am. Med.*, Burlington, Vt. and N. Y., 1908, n. s. iii, 479.
- MONRO, A.: *The morbid anatomy of the human gullet, stomach and intestines*. Edinburgh, Ramsay & Co., 1811, p. 464.
- MURRAY, R. W.: *Hernia*. 2nd ed., Phila., Blakiston, 1910.
- NIBLOCK, W. J.: Operations for hernia. *Indian M. Gaz.*, Calcutta, 1910, xlv, 410-414.
- NOBBE, W.: *Ueber den Canalis Nuckii und seine Beziehungen zu Leistenhernien*. I. D., Leipz., 1895.
- RAW, N.: See Murray, R. W.: p. 34-38.
- RUSSELL, R. H.: The etiology and treatment of inguinal hernia in the young. *Lancet*, Lond., 1899, ii, 1353-1358.
- SCARPA, A.: *Sull'ernia memorie anatomico-chirurgiche*. Pavia, ii ed., 1819. Dalla Stamperia Fusi e co. success. Galeazzi.
- SCHMIDT, M.: Erklärungsversuch zur Genese gewisser Fälle von Hernia inguino-interstitialis (Goyrand) und Hernia inguino-properitonealis (Krönlein). *Arch. f. klin. Chir.*, Berl., 1885, xxxii, 898-922.
- SPEED, K.: Observations of inguinal lipomata based on 154 herniotomies. *Surg. Gynec. & Obst.*, Chi., 1914, xix, 373-376.
- STREUBEL, C. G.: *Ueber die Scheinreduction bei Hernien, und insbesondere bei eingeklemmten Hernien*. Leipz., 1864.
- TILLAUX, P.: *Traité d'anatomie topographique avec applications à la chirurgie*. 8 ed. Paris, Asselin et Houzeau, 1908.
- TINKER, M. B.: The peritoneal foveae and their relation to operations for the radical cure of hernia. *Phila. M. J.*, 1898, ii, 477-478.
- TRICK, H. R.: The dynamics of abdominal herniæ. *New York State J. M.*, N. Y., 1919, xix, 166-168.
- VELPEAU, A. A. L. M.: *Traité complet d'anatomie chirurgicale*. Paris, Méquignon-Marvis, 1837, ii, 158-159.
- WALDEYER, H. G.: *Hernia retroperitonealis, nebst Bemerkungen zur Anatomie des Peritoneums*. Breslau, F. W. Jungfer, 1868.
- WILKIE, D. P. D.: Observations on inguinal hernia, with special reference to hernia of the bladder and recurrent inguinal hernia. *J. Roy. Nav. M. Serv.*, Lond., 1916, ii, 272-281.

CHAPTER XI

SYMPTOMS, DIAGNOSIS AND PROGNOSIS OF INGUINAL HERNIA

Inguinal hernia presents the general symptoms common to all hernias, and additional ones that are due to the special conditions in the inguinal region.

The oblique variety will be considered first, because it constitutes 95 per cent of all hernias; and then the symptoms of direct hernia will be taken up.

FUNCTIONAL SYMPTOMS

1. The Symptoms of Beginning Hernia (First Stage).—The first stage of inguinal hernia is usually characterized by an uneasiness in the epigastrium, without actual pain, and often a “dragging sensation” referred to one of the costal margins and pain in the back corresponding to the ninth and tenth ribs.

I have noticed that in young infants there is sometimes a history of the baby having cried a great deal for a week or two previous to the onset of the hernia. Possibly the crying is the cause of the hernia, instead of a symptom.

2. Bubonocoele or Incomplete Hernia (Second Stage).—When the hernia has passed through the internal abdominal ring into the inguinal canal it is known as a bubonocoele. At this stage diagnosis may be difficult, and in infants the only symptoms may be restlessness and a slight bulging on crying. (Fig. 46.)

3. Complete Hernia (Third Stage).—When the hernia has passed the external ring it is known as a complete hernia. While it may not enlarge immediately, the tendency is for it to descend finally into the scrotum, when it becomes a scrotal hernia. (Figs. 47 and 48.) In the female the hernia descends into the labium majus, when it is known as a labial hernia.

Scrotal hernias, as well as the bubonocoeles, cause pain, gastrointestinal disturbances, nervousness and irritability. Pain over the internal abdominal ring may be one of the first symptoms of beginning hernia; it may be a cutting, burning or prickling sensation. Pain over the abdomen, usually in the region of the umbilicus, is also common and is often associated with nausea that follows traction on the mesentery; if traction is continuous, vomiting will result. Sometimes the pain is referred to the back, especially with the large hernias, in which pain of some sort is seldom absent. Hyper-

esthesia over the hernia or over the testis on the affected side is occasionally complained of.

I recently operated on a man, 68 years old, for recurrent hernia that reached nearly to his knees. The sac contained omentum, small intestine.



Fig. 46.—Right inguinal bubonocoele or incomplete hernia.

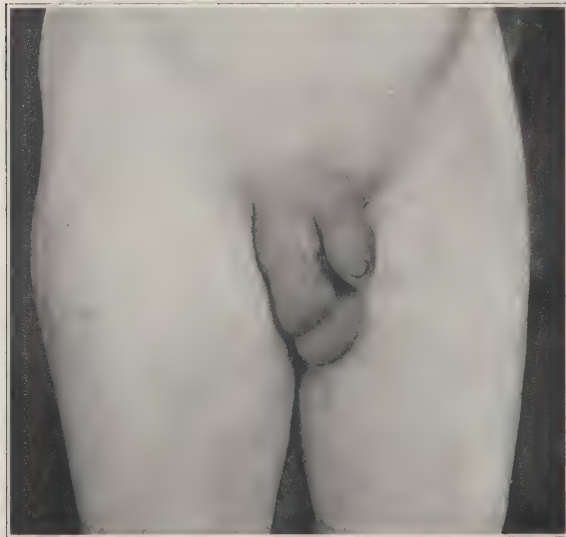


Fig. 47.—Complete inguinal hernia. Right oblique inguinal hernia of two years' duration. The hernia has entered the scrotum. The testicle can be seen lying below the hernia.

and a portion of the bladder wall. The only symptom the patient complained of was painful, frequent urination, every ten to fifteen minutes when he was on his feet. Medical treatment had afforded no relief. After opera-

tion, which restored the bladder to its normal position, the pain disappeared and micturition was reduced to four to six-hour intervals.

Prodromal pain along the course of the ilioinguinal and genitocrural nerves may be the first symptom of a beginning hernia. It is most frequent in the testis, or along the side of the scrotum or labium majus. When the external abdominal ring is being dilated, it is sometimes noticed there. It may rarely be referred to the side of the penis, to the hip, or into Scarpa's triangle.

The possibility of a painful hernia being due to a complicating appendicitis should always be borne in mind.



Fig. 48.—The same patient. Note the bulging over the inguinal canal. (Compare with Figs. 42 and 43.)

Objective Signs.—Beginning oblique inguinal hernias that bulge only at the internal ring are more easily seen than felt. With the patient reclining in a good light, a slight bulging may be seen on the affected side when he coughs or strains, and a definite impulse is obtained on palpation.

Hernias that have entered the inguinal canal or passed beyond it, are diagnosed easily, as a rule, by the presence of a tumor that gives an impulse on coughing when the patient is standing up. This impulse is the most important sign of hernia, and the examiner can detect it readily by placing his hand over the inguinal region, or by passing his finger up the inguinal canal, when the external ring is dilated.

To explore the canal, place the index finger on the testis and push up-

ward through the external ring at the same time invaginating the scrotum. The spermatic cord will be felt at the point where it passes over the os pubis; follow it back with the finger to the internal ring, where an impulse on coughing will be felt in oblique inguinal hernia. In direct inguinal hernia, instead of passing obliquely outward to the internal ring, the finger will enter the abdominal cavity directly behind the external ring, and the cord will be to the outer side.

In large oblique hernias the inguinal canal loses its obliquity owing to the dilatation of the internal ring, which may reach the outer border of the rectus muscle. In this case the internal ring is directly behind the external ring. A complete obliteration of the inguinal canal is rare, and it is usually possible to find enough of the inguinal canal remaining to preserve the oblique direction of the neck of the sac.

In direct hernia the epigastric artery is at the outer side of the aperture, but on account of its small size and the nature of its coverings, it cannot be felt. Those who pretend to feel it surrender themselves to a flattering delusion (Macready).

Percussion.—If the hernia contains intestine near the surface, a resonant note can be elicited on percussion unless the intestine is collapsed, contains fluid, or is covered by a layer of omentum. Fabre was able to diagnose an inguinal hernia of the stomach during life, because the mass became dull on percussion immediately after the patient ate or drank.

Reflex Objective Signs of Beginning Hernia.—According to Cosens, who examined 20,000 soldiers, the rectus muscle on the affected side is often more tense than the one on the sound side. With the patient in the erect position and head up, pressure over the external rings will cause him to complain of pain on the weak side. There is often pain referred to a point above the umbilicus.

Reducible Hernia.—If the hernia contains small intestine, the last portion often reduces suddenly and with a gurgling sound if it contains fluid. Occasionally the coils of intestine can be seen through the sac wall if it is thin. A sac that contains omentum is often irregular in shape, and the fatty lobules can sometimes be felt. Appendices epiploicae may be mistaken for omentum. Omentum reduces more slowly than intestine and without gurgling.

In irreducible hernias it is usually impossible to distinguish the contents unless the sac is very thin.

INTERPARIETAL HERNIAS (PROPERITONEAL, INTERSTITIAL AND INGUINOSUPERFICIAL)

1. **Properitoneal Hernia.**—The symptoms of properitoneal hernia are often indefinite, and diagnosis is seldom made before operation. There is usually no swelling in the inguinal region to indicate hernia. When strangu-

lation occurs, it is usually mistaken for intestinal obstruction. The hernial sac accompanying the cord may be empty or it may contain contents that are easily reducible, while the loculus of the sac, which is properitoneal, will be found to contain the strangulated intestine.

A fullness over the iliac region, complicated by an undescended testis, should lead the examiner to suspect a properitoneal hernia. Properitoneal hernia is sometimes mistaken for an ordinary inguinal hernia reduced *en masse*.

2. Interstitial Hernia.—Interstitial hernia is easier to diagnose than the properitoneal variety, because it is more superficial, lying between the aponeurosis of the external oblique and the internal oblique muscles. It is usually associated with undescended testis which may make diagnosis confusing.

Strangulated interstitial hernia may be mistaken for appendicitis, as in the case reported by Rowlands, in which the symptoms had persisted for three days, and at operation a kinking of the cecum in an interstitial hernia was discovered.

3. Inguinosuperficial Hernia.—Inguinosuperficial hernia lies on the aponeurosis of the external oblique, and is almost always associated with the undescended testis. The sac passes out through the external ring, and pressure at this point will prevent the descent of the hernia, just as it will in oblique reducible inguinal hernia.

Massive Hernias.—Very large hernias are usually irreducible and may rarely contain nearly all of the movable abdominal viscera which may cause severe gastrointestinal symptoms, such as colic, nausea, vomiting, constipation, and occasionally vesical disturbances.

These hernias may reach below the knees and may totally incapacitate the patient who often complains of a severe dragging pain and a sensation of weight. (Figs. 49 and 50.)

Scrotal Hernia.—After the hernia passes the external ring, it meets with little resistance in the upper part of the scrotum and rapidly passes downward to the bottom of the scrotum. It is usually pear-shaped, with the neck above at the external ring. (Fig. 51.)

Inguinal Hernia in Women.—In examining women for small inguinal hernia, it is sometimes difficult to locate the external ring. I have found the following procedure helpful: Place the finger near the external ring and direct the patient to cough; the sac can be felt as it bulges at the external ring, and the palpating finger easily follows the sac back into the inguinal canal.

Complications.—A contusion of a hernia may result in injury to the intestine, in the formation of a hematoma, either in the sac or in the subcutaneous tissues; and in a tear of the sac and overlying structures, followed by extrusion of the hernial contents. Other complications are: Foreign bodies in the sac; epiploitis; new growths, either in the sac or in adjacent

structures, such as disease of an ectopic testis; intrasaccular constrictions, and old voluminous hernias that cannot be controlled by any kind of retentive appliance.

A number of cases of reducible inguinal hernia have been reported in which accidental blows on the tumor were followed by rupture of the intestine.

Massive and Irreducible Hernias.—In massive hernias, which are usually irreducible, the sac may contain more or less of the following viscera: Large and small intestine, omentum, bladder, stomach, liver, spleen, pancreas; and in the female, the pelvic organs. In obese subjects these large hernias cause a slipping of the abdominal wall. In men the penis disappears within the



Fig. 49.—Massive irreducible left inguinal hernia (Hernia Magna) in a man. (Courtesy of Dr. A. M. Collins).

tumor, the urine causes frequent excoriations, and occasionally ulceration complicates conditions. (Fig. 52.)

When enormous hernias are associated with hydroceles, they are called *Gibbon's hydrocele*.

Strangulated Hernia.—Strangulation is the most common complication of oblique inguinal hernia. It is rare in direct hernia, but when it occurs it is usually at the external ring. The possibility of additional constrictions, as well as a properitoneal hernia or one that has been reduced *en masse*, should always be borne in mind while operating for strangulation.

The diagnosis of strangulated inguinal hernia is sometimes difficult, especially in children, in whom vomiting and gastrointestinal disturbances from other causes are common. The diagnosis is based on the finding of an

irreducible inguinal hernia, or the history of one that has been reduced *en masse*, and the symptoms of intestinal obstruction. As a rule, all symptoms are less severe in the old than in the young, in old hernias than in new ones, and in omentoceles than in enteroceles. (The differential diagnosis is similar to that of irreducible nonstrangulated hernia, and is considered in the section on differential diagnosis.)



Fig. 50.—Massive irreducible left inguinal hernia in a woman. (Courtesy of Dr. E. A. Balloch).

Strangulation of a previously reducible hernia is often accompanied by a severe, colicky pain, which increases in violence as the strangulation progresses. Old irreducible hernias cause a certain amount of pain and discomfort all the time, and the pain of a beginning strangulation is less definite than in the reducible variety.

As the condition continues, obstruction becomes absolute and is almost



Fig. 51.—Large bilateral, reducible, inguinal hernia in a man aged 71. The tumor is pear-shaped, with the neck above at the external ring.



Fig. 52.—Massive irreducible left inguinal hernia in a man. The penis has completely disappeared from view and there is a large ulcer involving the lower part of the scrotum. (Courtesy of Dr. A. O. Singleton.)

always followed by vomiting—first of the stomach contents, then fecal matter from reverse peristalsis of intestines. The pulse becomes rapid and thready; collapse and shock are marked and the temperature, at first elevated, usually becomes subnormal. When death takes place it is almost always due to shock, cardiac failure, peritonitis, inanition or uremic coma.

Judd reported the case of a man, aged 64, who had had a strangulated inguinal hernia four days and did not vomit at any time. At operation gangrenous intestine, which had perforated into the sac, was found. Resection was done and the patient recovered.

Strangulated Hernia in the Female.—Strangulated hernia in the female is rare, due probably to the fact that inguinal hernia is not common in women, and when it does occur, it seldom becomes large. Royster reported 3 cases.

Complications of Strangulated Hernia.—The complications of strangulated hernia are gangrenous intestine, perforation with an abscess in the sac, fecal fistula and peritonitis.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of inguinal hernia can be most conveniently considered under the following headings:

1. The differential diagnosis of direct and oblique inguinal hernia.
2. The differential diagnosis of inguinal hernia from other diseases.
- . The differential diagnosis of complete inguinal hernia.

I. Reducible.

II. Irreducible.

The differential diagnosis of incomplete inguinal hernia.

I. Reducible.

II. Irreducible.

1. The Diagnosis of Direct and Oblique Hernia

DIRECT AND OBLIQUE INGUINAL HERNIA.

DIRECT HERNIA

Rare

Globular in shape

Spermatic cord in front and external

Situated high and at outer border of rectus.
Does not descend into scrotum.

Often history of sudden onset after trauma.

Is uncommon before the age of 30 years.

OBLIQUE HERNIA

Common

Pear-shaped

Cord usually behind and internal.

Usually in the scrotum with the neck of the sac further to the side than in the direct variety.

Often appears without any apparent cause.

May appear at any age.

It may sometimes be impossible to differentiate a small incomplete oblique hernia with obliteration of the conjoined tendon from a direct hernia.

2. The Diagnosis of Inguinal Hernia from Other Diseases.—

I. *The Differential Diagnosis of Complete Reducible Inguinal Hernia.*—

(a) *In the Male.*—In the male the conditions that most frequently cause enlargement in the scrotum which diminishes on pressure or may disappear, are, scrotal hernia, varicocele and congenital hydrocele.

HERNIA	VARICOCELE	CONGENITAL HYDROCELE
Occurs at all ages.	Between 15 and 40 years.	In infancy.
Pyriform in shape.	Irregular and nodular.	Pyriform.
Feels soft and elastic.	Soft like "mass of angle worms."	Hard and elastic.
Expansile impulse on coughing.	No definite impulse.	Usually absent; if present, only slight.
Not translucent in adult; rarely so in infancy.	Non-translucent.	Translucent.
No fluctuation.	No fluctuation.	Fluctuation can be obtained.
Usually resonant on percussion if intestine is in the sac; dull with omentum alone.	Dull.	Dull.
Gurgling on auscultation if intestine is present.	Negative.	Negative.
On reduction, there is a feeling of a solid nodular mass slipping away from the fingers, and a gurgle if intestine is present.	Does not reduce.	Fluid can be forced slowly back into abdomen without causing symptoms.
May disappear entirely when patient lies down.	Always disappears in recumbent posture.	Does not disappear.
Hernia will not reappear on assuming an upright position as long as the examiner makes pressure with his fingers over the external ring.	Will reappear in spite of pressure.	Reappears slowly.

(b) *In the Female.*—In the female the diagnosis of inguinal hernia is much easier than in the male. The only reducible swelling likely to be encountered in the female is varicosity of the labial veins, which usually appears during pregnancy. The differential diagnosis between complete inguinal hernia and femoral hernia is usually simple in either sex.

COMPLETE INGUINAL HERNIA	FEMORAL HERNIA
The hernia makes its exit through the external ring internal to the spine of the os pubis.	The hernia is entirely external to the spine of the os pubis.
A protrusion of the hernia causes a distention of the inguinal canal.	The inguinal canal is empty.
Reduction by taxis is upward, outward and backward.	Direction of reduction is upward and backward.

II. *The Differential Diagnosis of Complete Irreducible Inguinal Hernia.*—

In the male, an irreducible scrotal tumor may be a scrotal hernia, a hydrocele of the cord or of the tunica vaginalis, an inflammation or new growth of the testis, an ectopia of the testis, or a hematocele.

The swelling of hydrocele is usually sharply circumscribed from the abdomen, while in hernia it appears to be directly continuous with the abdominal wall. (Figs. 53 and 54.) The differential diagnosis of hernia and



Fig. 53.—Hydrocele of the tunica vaginalis testis in a man aged 50.



Fig. 54.—Large tense hydrocele extending up into the inguinal canal as far as the internal ring. Unless a herniorrhaphy is done at the time of the hydrocele operation, patients with this type of hydrocele nearly always develop a hernia.

hydrocele was fully described by Dionis in 1698, including the transillumination test with a candle.

In infants, a hernia is sometimes translucent owing to the thinness of the intestinal wall. This should be remembered in differentiating hydrocele and hernia in youngsters.

Acute Encysted Hydrocele of the Spermatic Cord.—Acute encysted hydrocele of the spermatic cord is sometimes mistaken for strangulated hernia, on account of the symptoms of nausea, vomiting and pain associated with a recently formed, hard, tense tumor. In acute encysted hydrocele, there is usually a history of trauma, followed by pain and the appearance of a tumor which is translucent. The cord can often be palpated between the swelling and the external ring.

THE DIFFERENTIAL DIAGNOSIS OF COMPLETE IRREDUCIBLE INGUINAL HERNIA

HERNIA	HYDROCELE	INFLAMMATION, NEW GROWTH OR ECTOPIA OF TESTIS	HEMATOCELE
History of previously reducible swelling of slow growth.	Always irreducible and of gradual formation.	Always irreducible and of slow formation.	History of onset after injury.
Appearance pyriform.	Usually globular.	Rounded or oval.	Globular; often ecchymosis is seen soon after injury.
Feels soft and semi-elastic.	Tense and elastic.	Firm, often irregular.	Tense and elastic.
Expansile impulse on coughing.	No expansile impulse.	No impulse.	No impulse.
Not translucent.	Usually translucent.	No translucency.	No translucency.
No fluctuation.	Can be obtained.	None unless fluid is also present.	Can be obtained in most cases.
Resonant on percussion if intestine is in sac.	Dull.	Dull.	Dull.
Gurgling on auscultation if intestine is present.	Negative.	Negative.	Negative.
Spermatic cord is behind and hidden by hernia.	Plainly palpable above swelling.	Plainly felt; vas may be enlarged and sensitive.	Easily felt above tumor.
Testis usually easily felt behind and below hernia.	Not felt if sac is tense; can be seen by transillumination	Epididymis or body of testis can be palpated.	Cannot be felt, as a rule; lies below and behind.

IRREDUCIBLE HERNIA	CYST	ABSCESS	FIBROUS TUMOR	HYDROCELE OF CANAL OF NUCK
Very rare.	Not uncommon.	Frequent.	Rare.	Rare.
Feels soft and semi-elastic.	Tense.	Tense.	Soft or hard, non-elastic.	Tense.
Expansile impulse on coughing.	None.	None.	None.	None, as a rule.
Not translucent.	Usually translucent.	Not translucent.	Not translucent.	Often translucent.
No fluctuation.	Present.	Present.	None.	Present.
Resonant on percussion if intestine is in sac.	Dull.	Dull.	Dull.	Dull.
Inguinal canal distended by neck of sac.	Empty.	Empty.	Empty.	Empty.

Hydrocele of a Hernial Sac.—A hydrocele of a hernial sac must sometimes be differentiated from a hydrocele of the tunica vaginalis. In the former there is a history of a previous reducible swelling and a fullness in the inguinal canal; the neck of the sac can be traced to the internal abdom-

inal ring and a portion of the tumor is often translucent. A hernia and a hydrocele of the processus vaginalis may exist in the same scrotum on the same side.

Congenital Hydrocele in Children.—In children with congenital hydrocele, the fluid will disappear from the scrotum if the child is held up by the feet with his head downward.

Keller reported a case that illustrates the danger in mistaking a hernia for a hydrocele: A man, aged 58, was tapped twice with a trocar and cannula and only a little blood obtained. Severe pain developed soon after, and at operation 10 hours later, a strangulated hernia was found with considerable hemorrhage in the sac. Death from peritonitis followed on the fourth day.

Ascites.—A sudden accumulation of ascitic fluid with an old irreducible hernia may be mistaken for a strangulated hernia. If there is dullness over the abdomen, which changes with the patient's position, paracentesis abdominis will clear up the diagnosis.

Irreducible Hernia in the Female.—An irreducible inguinal hernia in the female must be differentiated from irreducible tumors of the labium majus, such as a cyst, which may be glandular; a hydrocele of the canal of Nuck; abscess, and a fibrous tumor. Hydrocele of the canal of Nuck is more common in children than is generally supposed.

Sturmdorf observed the case of a woman, aged 34, who had occasional attacks of pain and fullness just internal to the inner side of the right anterior superior spine of the ilium. In the last attack the symptoms simulated peritoneal suppuration with peritonitis. At operation, a strangulated properitoneal right inguinal hernia was found.

The Diagnosis of Incomplete Inguinal Hernia.—

I. The Differential Diagnosis of Incomplete Reducible Inguinal Hernia.—In the male, the diagnosis of an incomplete reducible hernia is usually a simple matter. About the only condition that is liable to cause confusion is a funicular hydrocele, in which the processus vaginalis has been obliterated near the external ring, but is open above, still communicating with the peritoneum. This is an uncommon variety of hydrocele, and although it is reducible, it is not accompanied by any other symptoms of hernia. In the female, a funicular hydrocele may occur in the canal of Nuck.

Incomplete reducible inguinal hernia, or bubonocoele, must not be mistaken for a reducible femoral hernia. In males the diagnosis presents no difficulties, but in females the examiner must be on his guard, especially if the patient is obese.

INCOMPLETE REDUCIBLE INGUINAL HERNIA	REDUCIBLE FEMORAL HERNIA
Hernia above Poupart's ligament which can be felt below the hernia.	Hernia in front of and covers inner end of Poupart's ligament.
Inguinal canal distended by the hernia. Impulse on coughing.	Inguinal canal is empty, and no impulse obtained by coughing.
Direction of reduction is outward, upward and backward.	Direction of reduction is downward, backward and upward.

II. *Differential Diagnosis of Incomplete Irreducible Inguinal Hernia.*—An incomplete inguinal hernia that is irreducible must be differentiated in the male from the following conditions: A partially descended testis, a hydrocele of the processus vaginalis of a partially descended testis, an encysted hydrocele of the cord in the inguinal canal, a dermoid cyst of the inguinal canal, a hematoma or lipoma of the cord, and malignant growth of the cord.

A partially descended testis is recognized by the shape and consistency of the tumor, and by the absence of a testis in the corresponding side of the scrotum. (Figs. 55 and 56.) If the ectopia is complicated by a hydrocele, diagnosis will be difficult. A normally descended testis may be temporarily drawn up into the inguinal canal by the action of the cremaster muscle;



Fig. 55.—Partially descended testicle in a man aged 22 years. The right testicle is just below the external ring.

this happens most often in children, and a second examination is frequently required to make the diagnosis.

Encysted hydrocele of the cord is a tense fluctuating tumor, which is attached to the cord and moves with it. The hydrocele is translucent, and the cord can be palpated between the external inguinal ring and the tumor. In a case reported by Johnson, the tumor appeared after the onset of pain following the strain.

Hematoma of the cord usually has a history of trauma with ecchymosis of the skin immediately following the injury.

A lipoma of the cord presents no symptoms except the soft fatty mass that has usually existed for a considerable length of time, without tendency to increase in size.

Malignant diseases of the cord are rare. They present a characteristic hard swelling, that may have followed an injury, and steadily increases in

size. I have seen metastasis extend along the cord into the abdomen very early in the disease.

In the female, an incomplete irreducible inguinal hernia must be differentiated from the following conditions: Hydrocele of the canal of Nuck, lipoma and other tumors of the round ligament, and dermoid cyst in the inguinal canal.

Hydrocele of the canal of Nuck is a tense, fluctuating tumor which cannot be forced out of the inguinal canal. If it is large, it may be translucent.

In Both Sexes.—Incomplete irreducible inguinal hernia is to be differentiated from the following conditions that affect both sexes: Inguinal adenitis,



Fig. 56.—Double undescended testes in a boy aged 12. On the right side the testicle is just below the external ring (Pubic variety); on the left side it is in the inguinal canal near the internal ring (Inguinal variety).

abscess in the inguinal region, psoas abscess, exostosis of the os pubis, aneurysm, lymphogranulomatosis, and in tropical regions, climatic bubo.

Inguinal adenitis presents an indefinite swelling, which is tender, painful, and often freely movable under the skin. Examination will show that the inguinal canal is empty and has no connection with the enlarged lymphatic gland. Other adjacent glands are often enlarged from the same source of infection. It should be remembered that in rare instances an abscess develops over the hernial sac. If this complication is suspected, great care should be taken not to wound the sac.

A psoas abscess may come to the surface above Poupart's ligament. It will present a reducible swelling that is dull on percussion, and gives a slight

impulse on coughing. Examination of the spine will disclose the source of the abscess.

Inguinal aneurysm is very rare, but always to be thought of when examining an obscure hernia.

Lymphogranulomatosis is due to an ameba, and disappears when emetin is given. Climatic bubo is due to an ameba or filaria, and responds to appropriate treatment.

PROGNOSIS

The prognosis of inguinal hernia depends on the age of the patient, the size of the hernia, and the condition of the sac contents.

Infants and Children.—In infants and children under 3 years old, small hernias can often be cured in a few months by a truss. After the age of four years, cure by a truss is comparatively rare and operative treatment is to be advised. Operation is also indicated in large or uncontrollable hernias in both infants and children.

The annoyance of the truss often makes these little patients nervous and irritable, backward in school work, and unable to participate in games with other children. While the danger of strangulation in young children is slight, it increases as the child grows older.

Uses and Limitations of the Truss in Adults.—Small hernias can sometimes be controlled with a truss. For those patients who refuse operation, palliative treatment is necessary to keep the hernia from becoming large and uncontrollable.

Every patient who wears a truss and believes it is properly fitted, knows that it is only a makeshift, that it will not cure his hernia, and that there is danger of strangulation at any time should the truss slip while he is engaged in active exercise. He also knows that if his hernia increases in size, as many do, that he will have to seek further treatment, and it is at this stage that many patients become easy prey for the charlatan or quack.

The irritation, annoyance, and physical discomfort caused by the truss are very pronounced, especially during the summer months, and at times are sufficiently serious to impair the health. Patients often remark that they were unable to do a full day's work until the hernia was cured by operation. A number of patients supposed to have been cured by a truss in infancy, have a return of their trouble in adolescence or early manhood. If the pressure of the truss has been firm, peritoneal adhesions form and a gradual decrease in the size of the abdominal opening usually results. It is difficult to adjust the truss to the fat subject so that it will hold the hernia, and at the same time afford comfort to the patient. At best, a truss is irksome, and tends to form adhesions rendering a later operation difficult; consequently recurrence is more frequent where a truss has been worn for a long period previous to operation.

Radical Operation.—Patients with simple reducible hernia often seek operation in order to be relieved of the discomfort and annoyance of the truss. The French term these cases "*operations de complaisance*."

Operation is to be recommended for every adult with hernia unless there are definite contraindications, such as advanced age, shock, hemorrhage, cardiovascular, nephritic or pulmonic lesions. Even these conditions that preclude general anesthesia, are no barrier to operation if local anesthesia is used. I have employed it successfully in nonstrangulated hernia in patients from five to eighty-five years old.

Local Anesthesia.—Local anesthesia is the anesthetic of choice for non-strangulated hernia in both children and adults. The operation can be done more thoroughly than with general anesthesia, because there is no need for haste, with the patient awake and comfortable. And to digress for a moment—the patient is comfortable and free from pain at all times during the operation, if the operator is skilled in using local anesthesia.

With local anesthesia there is no postoperative vomiting and straining to loosen the sutures. Complications, such as pneumonia, nephritis, shock, cardiac failure and acute dilatation of the stomach are eliminated, with the result that there is practically no mortality. Many patients will consent to operation under local anesthesia whose hernias would be forever neglected if the operation involved a general anesthetic, especially those who, at some time, have had a stormy and protracted convalescence after general anesthesia.

However, the local method is usually contraindicated in the patient who does not want it, who prefers for any reason to be asleep during the operation. It is often a mistake to urge local anesthesia on the skeptical, and as a rule, I administer a general anesthetic to this type of patient, providing, of course, that he is in every way a suitable risk for it.

Strangulation.—Strangulation is the greatest danger that confronts the hernia patient. It usually occurs when least expected, and the mortality following the emergency operation is high. To my mind this is the most important reason for urging operation for all nonstrangulated inguinal hernias. In 1,429 operations for strangulated inguinal hernia collected by Sultan, the mortality was 20.7 per cent.

The percentage of strangulation is highest in those patients whose hernias have been retained by a truss for a number of years, and have then suddenly come down. Most often the hernia accidentally slips by the truss during straining or exertion, but every once in a while a patient will turn up, who imagining himself cured, discarded his truss and the hernia unexpectedly recurred and strangulated. The point of constriction is usually the internal ring, rarely the external ring; both have become narrowed while the hernia was being retained by the truss. In patients who have never worn a truss, the rings are widely dilated and strangulation is not frequent.

Local Anesthesia in Strangulated Hernia.—The importance of local anesthesia in strangulation cannot be overemphasized. Its use will do more than anything else to reduce the mortality in these cases where shock and lowered vitality too often exact their toll. The local method provides ample time to determine the viability of the intestine, and if resection is necessary it can be done without additional risk to the patient.

Bibliography

INGUINAL HERNIA—SYMPTOMS

- COSENS, W. B.: Reflex phenomena produced by commencing abdominal hernia. *Practitioner*, Lond., 1918, c, 155-6.
- DIONIS, P.: *Traité complet des opérations de chirurgie*. Paris, B. Girin, 1698, p. 68-82.
- FABRE: See Velpeau, A. A. L. M.: *New elements of operative surgery*. 3rd ed., English transl. by P. S. Townsend, New York, S. S. & Wm. Wood, 1851, iii, 662-663.
- JOHNSON, R.: Acute encysted hydrocele of the spermatic cord. *Brit. J. Surg.*, Bristol, 1920-21, viii, 40.
- JUDD, J. R.: A case of strangulated hernia presenting unusual symptoms. *J. Am. Med. Assn.*, Chi., 1911, lvi, 1882-3.
- KELLER, W. F.: Report of an unusual case of inguinal hernia. *J. Minn. Med. Assn.*, Minneapolis, 1908, xxviii, 5-6.
- MACREADY, J. F. C. H.: *A treatise on ruptures*. London, Griffin & Co., 1893.
- ROWLANDS, R. P.: Interstitial hernia. *Med. Press & Circ.*, Lond., 1909, n. s. lxxxvii, 162-163.
- ROYSTER, H. A.: Strangulated inguinal hernia in the female. *Am. J. Obst.*, N. Y., 1911, lxiv, 472-477.
- STURMDORF, A.: A case of strangulated dissecting hernia, simulating peritubal suppuration; exsection; recovery. *Med. Rec.*, N. Y., 1908, lxxiv, 899.

CHAPTER XII

TREATMENT OF INGUINAL HERNIA

Small hernias in infants and children up to four years of age can sometimes be cured by a truss. After this age the truss is merely a palliative measure, and operation is to be recommended for all hernias, excepting the massive irreducible ones that have lost their *right of domicile* in the abdominal cavity, and those in which the hernial opening is so large that there is little prospect of securely closing it. Palliative treatment may be necessary for exceptional patients whose condition does not warrant radical operation, even with local anesthesia.

Mechanical Treatment of Inguinal Hernia.—Bandage treatment dates from ancient times, being associated with the earliest references to hernia and probably represents the first attempt to relieve this affliction. According to Ponceet, it was used in 900 B.C., and Celsus described a girdle that was worn around the pelvis and fastened to a pad that compressed the hernia. The iron truss was introduced in 1306 by Gordon, and Gatinaria stated that trusses with an iron pad and circle were made in Italy at the end of the 15th century. The steel truss was first used in France by LeQuin in 1628, and Blakey introduced it into England in 1783.

The English cross-body truss, introduced in 1806, was devised for small easily reducible hernias. The spring is complete in front, and beginning at the pad over the inguinal canal, it passes across the pubis from the affected side to the sound side and continues three-fourths of the way around the pelvis to the buttock of the affected side. The pressure of the pad is inward and upward. At the present time the best truss is of the frame type, and it should be made of material that can be shaped in such a way that it fits into every curve and line in the circumference of the body without making undue pressure at any one point. I have found phosphor bronze is the best material, and it can be obtained in rolled wire form, or flat. It does not crystallize or corrode and usually lasts a lifetime. (Figs. 57 and 58.)

Different gauges are used, the heavier ones being required for patients with marked intraabdominal tension, and the lighter ones for those with only slight intraabdominal pressure.

Phosphor bronze is very light in weight and may be covered with hard rubber, celluloid, or soft leather; when leather is used, a soft padding must be put on the inside.

The size of the pad that is required to control the hernia must be determined by individual needs. The water-type pad is the best. It should have

a partition in the center and be filled with water *in vacuo*. The pad may be covered with a gum pouch, soft silk, or velveteen plush.

Objection is sometimes made to the use of leather and fabric on the body, but if the truss and pad are kept clean and the body carefully cared for, these soft materials are more comfortable than hard rubber and celluloid coverings. If the patient is to wear a truss constantly, it must be comfortable.

I make it a point to see that the pad and truss coverings are changed at least twice a year, and that the pad is kept sufficiently full of water to hold the hernia securely. The cost of this attention is small and it adds much to the patient's comfort.

Measuring for the Truss.—With the patient in the recumbent position, the measuring tape should be passed around the pelvis at the level of the internal rings, midway between the crest of the ilium and the great trochanter. The tape follows the obliquity of the pelvis, which is lower in front than behind. The distance between the inguinal canals should also be measured, as the pad must be closer together for direct than for oblique hernia.

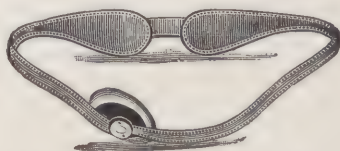


Fig. 57.—Frame truss for inguinal hernia. (Pomeroy).



Fig. 58.—Frame truss for double inguinal hernia (Pomeroy).

A diagram made with lead tape is valuable. A strip of this tape about $\frac{1}{2}$ inch (1.25 cm.) wide, $\frac{1}{16}$ of an inch (2 mm.) thick, and about 20 inches (50 cm.) long is used. Beginning at the median line just above the symphysis pubis, the tape is passed over the sound side, around the abdomen, over the hip on the opposite side and across the back. The lead is pressed to the form of the body and carefully removed, placed on a sheet of paper and a tracing made of its inner surface. The process is repeated for the opposite side. This procedure will give a diagram of the figure as well as the circumference of the body. With this diagram as a guide, the instrument maker can make an accurately fitting truss.

The pad of the truss should fit correctly over the inguinal canal and not over the external ring. In the latter position the hernia may slip by the truss, and the pressure on the spermatic cord as it passes over the pubic bone, is painful. To prevent pressure on the cord an oscillating water-pad should be used, and the frame angled to give more tilting to the pad.

Difficulties of Truss Treatment in Direct Hernia.—In direct inguinal hernia, truss treatment is unsatisfactory because the hernial opening is close to the pubic bone, passing directly back into the abdomen, and the hernial contents are difficult to retain. Pressure of the truss often causes pain, because the sac frequently contains intestine, bladder, cecum, or sigmoid. For these hernias the truss pad should be placed nearer the median line, and lower than for the oblique inguinal variety.

Little or no improvement follows the truss treatment in direct inguinal hernia; all that can be hoped for is that the truss will prevent the hernia from increasing in size.

Contraindications to Mechanical Treatment.—The following conditions may interfere with the fitting of a truss, and with the successful retention of a hernia: Hydrocele, cysts of the cord or in the canal of Nuck, varicocele, ectopia testis, ovary in the hernial sac, pregnancy, adhesions of hernial contents to each other or to the sac wall, and interstitial hernia.

On account of the danger of strangulation, irreducible hernia is not suited to truss treatment, and the radical operation should be done. When operative treatment is refused or contraindicated, a hinged cup-truss should be used. This truss has a concave cup with a felt pad which exerts pressure over the irreducible tumor. Instead of this truss, a supporting bag may be used, which is held in position by a belt and nonelastic suspenders passing over the shoulders.

The Point of Pressure on the Sac by the Truss.—The chief disadvantage of truss treatment is that the pad of the truss makes pressure on the sac in the inguinal canal, and if obliteration occurs from the irritation of the pressure, it takes place below and not at the internal ring. This is probably the reason so many hernias apparently cured by a truss recur in later life.

Mechanical Treatment in Infants and Children.—The best results from truss treatment are secured in children under 4 years of age. Some are cured up to 5 years, and a few up to 10 years. After this age, cure by truss is very rare. Hernia in infants is not accompanied by the difficulties encountered in adults. In youngsters it is almost always small, reducible and easily retained.

In children under 4 years of age, cure by means of a truss should always be attempted before operation is resorted to. The truss should be applied as soon as possible after diagnosis. An infant a few days old is not too young to wear a truss. The frame type is the best and it must be made very light. In the event of whooping cough or bronchitis, the truss should be temporarily strengthened. It is usually necessary for the child to wear the truss continuously day and night, for at least a year, to effect a cure. As the hernial ring diminishes in size, the truss should be adjusted. The child's skin must always be kept scrupulously clean and dry. The truss should be removed once a day for bathing, which should be done with the child lying as quietly as possible. If the hernia shows any tendency to pro-

trude, the nurse or mother should place her finger over the ring until the truss can be reapplied.

The diet should be regulated to overcome any tendency to constipation, flatulence, or a too rapid gain in weight. As the child grows, it is necessary to adjust the truss from time to time, and for this reason the physician should see his little patient at least twice a month.

Rules for Truss Wearing.—The adult patient should remove his truss after he is in bed, and put it on before arising in the morning. The truss must always be worn next to the body. It is dangerous to wear it over the underwear, and it should not be removed while taking a bath. A patient accustomed to a truss should never walk or stand without it, because if the hernia should come down the danger of strangulation is greater than if he had never worn a truss. When the patient has a cough, or if the hernia is very large, he should wear a light-weight elastic truss at night. If the hernia becomes painful or irreducible, the physician should immediately examine it for possible incarceration or strangulation. The irritation caused by the truss can be lessened if the parts are bathed daily, and a dusting powder, such as zinc stearate or talcum, used freely. The truss should be kept clean by washing it in water. A gain in weight should be guarded against.

Complications Resulting from Truss Wearing.—If the truss pad presses on the spermatic cord as it crosses the pubic bone, it is liable to cause varicocele, neuritis referred to the cord, or, in rare instances, atrophy of the testis. Cramp observed a case in which the pressure of the truss caused an ulcerating wound that extended through the skin, subcutaneous tissues and fascia down to the muscle.

Percentage of Cures with Truss.—Spanton stated that in a total of 96,886 patients treated by trusses at the London Truss Society, only 4,387 or 4.53 per cent were cured.

In infants and young children, a majority of small inguinal hernias will disappear with truss treatment. Coley stated that over 50 per cent are cured by this means; De Garmo claimed 75 per cent, while Ochsner estimated the cures at 95 per cent. There is no question that in some apparent cures the sac is only incompletely obliterated, and this explains why a small percentage have a recurrence later in life.

Gymnastic Exercises and Inguinal Hernia.—Systematic exercise has been advocated as a treatment for small oblique hernias in young adults by Seaver and McKenzie. This method is worthy of a trial in patients with well-developed muscles, who have small bubonocoeles and refuse operation.

The following strenuous exercises should not be indulged in by hernia patients. Football, riding horse-back, jumping, wrestling, hammer-throwing and shot-putting. As preventive measures of hernia, daily exercises to keep the recti and oblique muscles in a slight degree of tension are recommended. Deep breathing exercises are especially valuable in children.

The Injection Treatment.—The treatment of inguinal hernia by injections of paraffin or astringents is seldom used in the present day except by charlatans. Astringent injections were extensively employed before the advent of the modern operative treatment. Among the substances used were: Infusion of oak bark, iodine, zinc chlorid and alcohol.

The injection was made at the neck of the sac with the object of setting up sufficient inflammation to prevent the descent of the hernia. Among the serious complications which sometimes followed this method were peritonitis and sloughing of the abdominal wall.

In recent years, paraffin has been the substance most commonly injected. Quinin and urea hydrochloride has also been used. Almost always the hernia recurs a few days or weeks after injection; should it not reappear, it is usually only a question of time until the hard masses of paraffinomas will induce suppuration, causing so much pain that their removal is required. The paraffin is gradually replaced by a firm mass of scar tissue which has a tendency to undergo malignant change. When the injection treatment has been used, the radical operation is more difficult, and the hernia is more liable to recur than in uncomplicated cases.

In operating on paraffin hernias, I have found the paraffin masses in the inguinal canal, in the hernial sac, in the external oblique muscle, imbedded in the aponeurosis, and adherent to the vas deferens in the spermatic cord.

Among the serious accidents that have followed this treatment, may be mentioned: Injection of paraffin into the peritoneal cavity; wounding the intestine with resultant peritonitis; the injection of paraffin into the femoral artery or vein, resulting in gangrene of the extremity and necessitating a hip joint amputation. A number of such cases have been reported in the literature.

Thomson reported the case of a man who came under his observation a few days after treatment by the injection method. The patient stated that, immediately after the injection, he suffered severe pain, the foot and leg became blanched, gangrene developed and extended as high as the knee.

Pregnancy and Inguinal Hernia.—Inguinal hernias usually diminish in size during the latter months of pregnancy, because the enlarging uterus draws the sac contents back into the abdominal cavity, unless there are intrasaccular adhesions that hold the viscera in the sac. Sometimes the hernia entirely disappears, and on account of the decreased intraabdominal tension, it does not reappear for some time after delivery. Sooner or later it reappears and because of the relaxed abdominal muscles, it is larger than before. Parturition is one of the most frequent exciting causes of inguinal hernia.

Hernias that increase in size during pregnancy can be operated on safely with local anesthesia with slight chance of recurrence. This view has been corroborated by the experience of a number of surgeons. Gardiner has reported a number of cases treated successfully.

Treatment of Irreducible Hernia.—The early surgeons used a suspensory belt or bandage to prevent the increase in size of an irreducible hernia. In the 18th century Arnaud discovered that by using a belt that made firm and continuous pressure, an irreducible hernia sometimes could be reduced. Richter advocated keeping the patient in bed, on a light diet, at the same time making continuous pressure with a truss. Early in the 19th century the German physicians used bags of shot over the tumor, and the French were partial to firm pressure from an inelastic bandage.

2. Operative Treatment for Inguinal Hernia.—The modern operative treatment for inguinal hernia dates from the work of Macewen in 1886, Marey in 1881, Bassini in 1889, and Halsted in 1889, who were the first to advocate a free exposure of the sac and structures of the inguinal canal by open dissection, and a plastic reconstruction of the deeper layers of the abdominal wall. Since the advent of the open operation, the two points of controversy have been the disposition of the sac and the repair of the inguinal canal.

THE DISPOSITION OF THE SAC

A. Methods That Leave the Sac in the Inguinal Canal.—Macewen freed the sac up to the internal ring, cutting away a portion of it, if it was large, and folded the remainder of it upon itself in the form of a boss or a tampon and sutured it inside of the internal ring. Marey and Bassini ligated the sac and excised it near the internal ring.

Mollière endeavored to obliterate the sac by passing it through a piece of rubber tubing and compressing it with a strip of lead. Lucas-Championnière recommended opening the inguinal canal to expose the sac, which he excised. Duplay and Cazin split the sac into two strips, tied them together at the internal ring, and used them as sutures to close the hernial opening. Only superficial stitches, which could be removed were employed. Faure also advocated this method of closure. Reed sewed a portion of the sac transversely across the internal ring.

Friend separated the sac well within the internal ring, freed it from the cord, opened it and reduced the contents. Next, he divided the sac wall as far as the base of the sac, into four, six or eight ribbons and tied opposite ribbons together with a single knot, each successive knot overlying the preceding one, thus making the sac into a pad. A ligature of catgut was placed around the entire knot and the ribbon ends cut off. The pad was reduced into the internal ring and the canal closed in the usual manner. A similar operation was proposed by Frank (R).

Ball opened the sac, freed it of adherent omentum, ligated and twisted it. In congenital hernia, he divided the sac and left the serotal portion. He then passed a full curved needle, threaded with silk, one inch (2.5 cm.) beyond the internal ring into the subperitoneal space and brought it out through the muscles, fascia and skin; next passed the other end of the suture through the

base of the sac, brought it out through the abdominal wall also, and tied the ends together. Deep sutures were used to close the inguinal canal.

In 1892 Kocher recommended freeing the sac to the internal ring and making a slit in the aponeurosis opposite the internal ring. He passed forceps through this opening, grasped the sac, inverted it, and sutured it to the aponeurosis of the external oblique. Later he modified this operation as follows: He brought the sac through an incision in the aponeurosis, crushed its base, transfixed, ligated and excised it. The stump was allowed to drop back, and he closed the canal by suturing the internal oblique, conjoined tendon, and the aponeurosis of the external oblique to Poupart's ligament over the cord.

After closing the neck of the sac with a pursestring suture, Leonté sought to obliterate the scrotal portion of the sac by curetting its peritoneal surface. Wölfler used a thermocautery to produce occlusion of the sac. Elkourie did not remove the sac or attempt to separate it from the cord. After opening it and reducing the contents, he introduced a pursestring suture through the neck at the internal ring, tightened and tied it. The interior of the sac was rubbed with gauze, the walls approximated with three or four stitches, and the wound closed in the usual manner without transplanting the cord. Sellenings closed the sac at the internal ring with a pursestring suture, traumatized the interior of the sac with gauze, and obliterated it by a running suture of catgut extending from the internal ring to the fundus.

Pond opened the sac, traumatized the peritoneal surface by swabbing with a dry sponge, then inverted the sac on a forceps introduced from above through a slit in the aponeurosis of the external oblique. The fundus of the sac was drawn up to the split and interrupted sutures were passed through the sac as it lay beneath the aponeurosis.

Petrulis left the sac attached to the cord, but divided it at the neck after ligating it. He said that in 21 patients treated by this method the results were good.

B. Methods That Fix the Sac or the Stump of the Sac to the Internal Abdominal Wall.—Barker's operation for fastening the stump of the sac to the internal abdominal wall is probably the most important one: The sac is freed to the internal ring, opened, and the contents reduced. A ligature is placed as high up as possible and the sac excised one-half inch (1.25 cm.) below this point. One of the free ends of the ligature is threaded in a needle, and with the stump of the sac pressed back, the needle takes a bite in the lower border of the internal ring. It is then passed forward and upward beyond the ring with the index finger as a guide, and brought out through the muscles and fascia above the internal ring. The other end of the suture is passed in the same manner. The ends are tied, drawing the neck of the sac inside the peritoneal cavity and closing the internal ring, and the inguinal canal is closed by interrupted sutures.

Bennett (W. H.) used an operation similar to Barker's, except that he invaginated the neck of the sac. He freed the sac to the internal ring, and excised it at the level of the external ring. A ligature threaded in a needle was passed through the aponeurosis of the external oblique and muscles into the peritoneal cavity above the internal ring. This suture was brought out through the neck of the sac, and with it a pursestring suture was made around the neck of the sac. The ligature was then carried back through the peritoneum, muscles and fascia and the ends tied, thus closing the neck of the sac and invaginating it into the abdominal cavity.

Baxter freed the sac, enlarged the opening at the internal ring, and attached the sac to the peritoneal surface by through-and-through sutures. The deep ring was closed by two crown sutures similar to those used in perineorrhaphy. Kingseote formed a plug out of the sac and sutured it inside of the internal ring, which he closed with interrupted sutures.

Macewen used the sac to form a plug at the internal ring: He freed the sac for a distance of an inch (2.5 cm.) beyond the internal ring, opened it and reduced the contents. The sac was folded upon itself and sutured with through-and-through stitches, which passed in a zig-zag fashion from the fundus to the neck, the last two bites of each stitch being taken on a level with the internal ring. Using the finger as a guide, the needle was passed through the muscles and fascia above the ring and made to emerge through the skin. Traction on this suture puckered up the sac, which was drawn upward and inward through the internal ring. If the sac was large, a portion of its fundus was cut off.

Bishop freed the sac to the internal ring, and after incising it and emptying its contents, he passed a needle carrying a long ligature the length of each wall from the neck to the fundus. The ends of the ligature were passed through the abdominal wall from within outward, just inside the internal ring. Traction on these ends invaginated the sac inside of the abdomen.

In small hernias, Phelps passed a pursestring suture around the neck of the sac, carried the ends through the open sac and brought them out above the pursestring suture, so that when they were tied the stump of the sac was inverted. In large hernias he used a method similar to Bishop's.

Lexer made an incision two inches (5 cm.) above the internal ring and just internal to it, through the external oblique, internal oblique and transversalis muscles. He introduced a long forceps through this opening, grasped and inverted the sac, ligated it at its base and excised it. The stump was sutured to the muscles, the opening closed, the inguinal canal being repaired by the Bassini method.

Methods Which Do Not Free the Sac.—The early operators did not remove the sac but simply closed the opening at the level of the peritoneum and sutured the inguinal rings. Stokes followed this method, and Paget, in 1872, warned against opening the sac on account of the dangers of peritonitis.

Franks reduced the sac and contents without ligating the sac. Czerny opened the sac at the neck and closed it with a pursestring suture. Socin used a pursestring suture at the neck, cut the sac transversely below the ligature, pushed the upper portion of it up inside of the internal ring, and left the lower portion undisturbed.

Buchanan employed a similar operation, excepting in congenital hernia he used the lower portion of the sac as a covering for the testis, and the upper part as a plug to close the internal ring. Terrillon sutured the walls of the sac together from the bottom up to the internal ring. Goodwin cut away all of the sac except the portion adherent to the cord. The edges of the part remaining were brought together and sutured over the cord and testis. Bottini resected a portion of the sac only when it was voluminous.

The Repair of the Inguinal Canal.—At the present time, primary union is known to be the most important factor in preventing a recurrence. The older surgeons believed that a wound had a stronger cicatrix when it healed by suppuration. McBurney packed the wound with gauze to keep it from healing too rapidly.

METHODS THAT DO NOT DISTURB THE INGUINAL CANAL

A. Suture of the Pillars.—Félizet, Banks, Reverdin, and Czerny were content to bring the pillars of the inguinal canal together with two or three sutures. Landerer sutured the inferior pillar inside the external ring.

B. Plaiting the Aponeurosis of the External Oblique.—Before the adoption of the method of overlapping flaps of fascia, as originally proposed by Lucas-Championnière in 1881, when the aponeurosis was loose and relaxed, the redundant portion was folded on itself and secured by mattress sutures, as described by Kocher, and Le Dentu.

C. Reconstruction of the Floor of the Canal.—Ester and Mermingas reconstructed the floor of the inguinal canal, leaving the anterior wall intact.

METHODS THAT OPEN AND RECONSTRUCT THE INGUINAL CANAL

There are several advantages in opening the inguinal canal: It permits a complete dissection of the sac, closure of the internal ring, and repair of the canal floor. Lucas-Championnière split the aponeurosis of the external oblique in the direction of the inguinal canal to expose the neck of the sac, which he ligated at the internal ring as high as possible; this step prevents leaving a funnel-shaped prolongation of the peritoneum. The aponeurosis of the external oblique was overlapped from above downward by two rows of mattress sutures.

Marcy's Operation.—Marcy, in 1881, was the first to advocate high ligation of the sac, transplantation of the cord, and reconstruction of the inguinal canal as they are practiced today. He freed the sac to a point within the internal ring, and drew it firmly downward so as to make the parts tense. It was then sewed across the neck with a continuous double suture of fine kangaroo tendon and excised. The stump of the sac was carried within the internal ring, and the cord lifted up and retracted toward the median line. A full curved needle threaded with kangaroo tendon was passed through the posterior edge of Poupart's ligament on the outer side; and carried inward and emerged from behind forward through the thick aponeurosis of the fascia

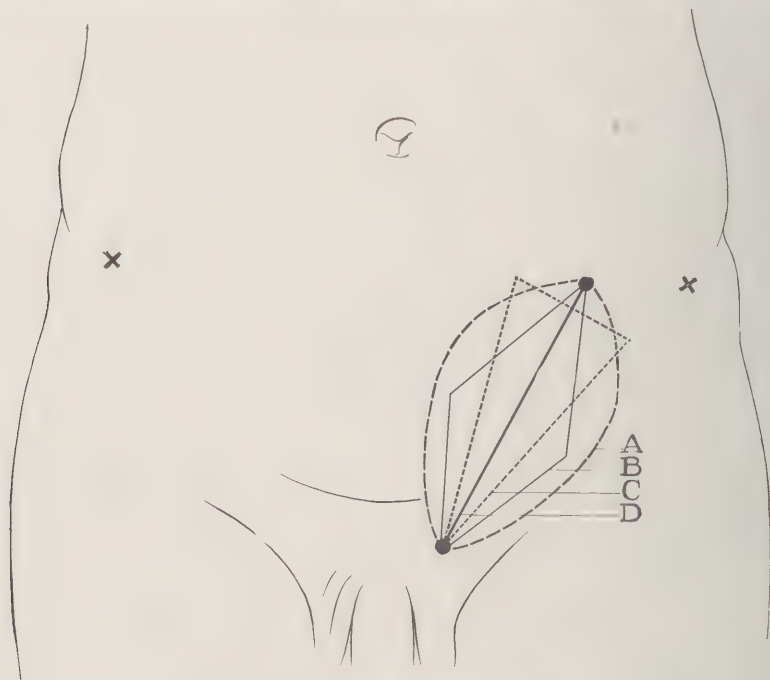


Fig. 59.—Infiltration anesthesia. Methods of injecting the skin so as to avoid infiltrating the line of incision.

transversalis. The sutures were placed about one-third of an inch (8 mm.) apart, and the internal ring closed from below upward until the cord was restored to its original point of exit from the abdomen. Before suturing the conjoined tendon to Poupart's ligament, in large hernias approaching the direct variety, Marcy introduced several stitches through the peritoneum, fascia and muscles to strengthen the structures that form the floor of the canal and to restore its obliquity. Having thus reconstructed the posterior wall, the cord was replaced.

A needle threaded with kangaroo tendon was passed from without inward through Poupart's ligament at a level with the reformed internal ring, and carried through the firm muscular and tendinous structures on the inner side

of the canal. These stitches were continued downward and inward over the cord until the external ring was restored to its normal size. The skin was closed by a buried continuous suture. Marcy did not use drainage, and he was the first to use absorbable sutures in hernia operations.

Bassini Operation.—In 1883 Bassini attempted to cure inguinal hernia by ligating the sac at the internal ring, stitching the stump to the posterior surface of the external oblique and using a portion of the neck of the sac as a tampon to close the inguinal canal, finally bringing the edges of the aponeurosis together and closing the skin. He soon realized that this method



Fig. 60.—Infiltration anesthesia for inguinal hernia operation. (a) The first injection of the skin is usually made near the center of the proposed line of incision. (b) The infiltration is continued upward; (c) the lower part of the incision is injected.

had the same fault as the operations described by Wood, and Czerny—that recurrence took place unless the patient wore a truss after operation—so he abandoned it.

The principal features of the Bassini operation are: High dissection of the sac, transplantation of the cord and the repair of the posterior wall of the inguinal canal to restore its obliquity. Silk was used for all sutures. The edges of the aponeurosis were only approximated. The patient was placed in a plaster-of-Paris cast and kept in bed for six weeks. In 1889 Bassini reported 262 operations by this method.

In the past, innumerable operations have been described, either to modify

the Bassini method or to replace it altogether. Some of these procedures were without merit and others were discarded because they were too complicated. At the present time, surgeons are continually reviving old methods thinking they have discovered something new, when if they would look up the literature, they might find their theories had been tried out and discarded long ago. A recent example of this is a so-called "new" operation for oblique inguinal hernia that is identical with the original Halsted operation, described in 1889 and abandoned by Halsted himself years ago. However, a few of the operations are of exceptional merit and their technic is given in detail.

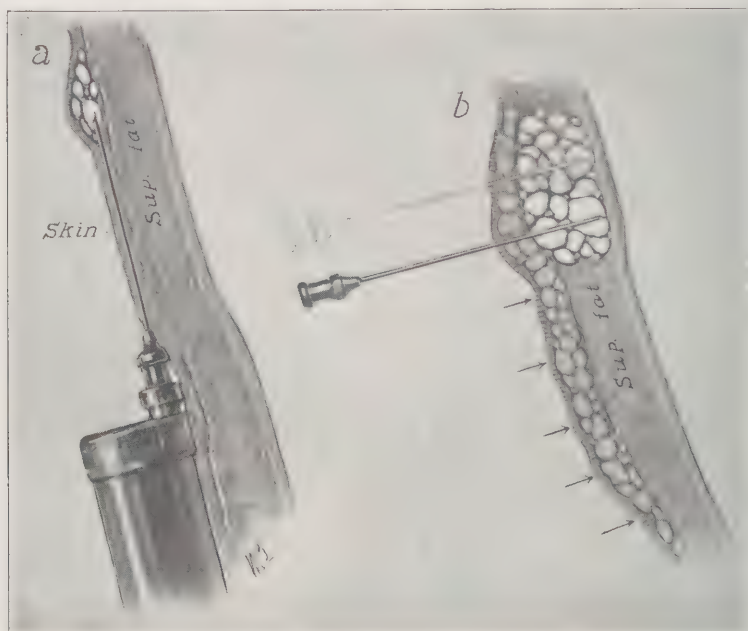


Fig. 61.—Infiltration anesthesia for inguinal hernia operation. Cross section showing: (a) The anesthesia of the skin; (b) the infiltration of the subcutaneous tissues down to the aponeurosis.

Local Anesthesia.—Local anesthesia is the anesthetic of choice for the majority of hernia operations. There are three principal methods of inducing it: Infiltration, regional or block, and paravertebral anesthesia.

1. *Infiltration Anesthesia.*—Infiltration anesthesia is the most popular method of local anesthesia. It is simple, easily accomplished and its only drawback is that it takes more time than the regional method. The technic for infiltration anesthesia is given in the drawings illustrating the modified Bassini operation on the following pages. (Figs. 59, 60, and 61.)

2. *Regional Anesthesia.*—Regional or block anesthesia for the inguinal hernia operation is carried out as follows: A point is selected two-finger-breadths or 1 inch (2.5 cm.) internal and just below the anterior superior spine of the ilium, and a wheal is made in the skin as described under infil-

tration anesthesia. A fine needle 4 inches (10 cm.) long is now attached to the syringe and introduced through the anesthetized area, and a number of injections made at different points on a line between the umbilicus and anterior superior spine. The injecting needle passes through the aponeurosis, the external oblique, the internal oblique and the transversalis muscles. The first two or three injections are made towards the umbilicus to block the

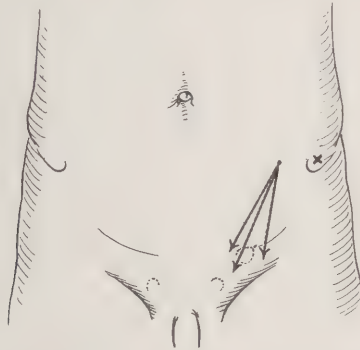


Fig. 62.—Regional anesthesia. The lateral arrows indicate the subaponeurotic injections to the inner and outer side of the internal ring. The central arrow is the injection to block the cord structures.

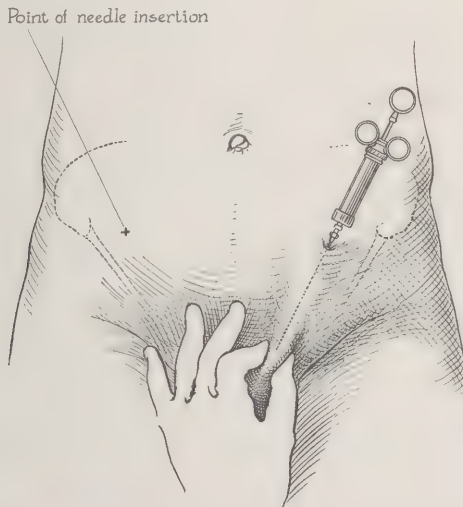


Fig. 63.—Regional anesthesia. A long needle is passed down through the subcutaneous tissue to a point below the external ring, and the cord injected while it is held up between the thumb and forefinger.

last two dorsal nerves, and succeeding injections are in the direction of the spine of the ilium to block the iliohypogastric and ilioinguinal nerves. An injection is next made beneath the aponeurosis just to the outer side of the internal ring, and a second one just to the inner side. This gives a fan-shaped area of nerve block. To block the cord below the external ring, the long needle is partially withdrawn and passed down through the sub-

cutaneous tissues to a point below the external ring and the cord injected while it is held up between the thumb and forefinger. (Figs. 62, 63, and 64.)

3. *Paravertebral Anesthesia*.—Paravertebral anesthesia for the inguinal hernia operation is accomplished by blocking the last three intercostal nerves and the first four lumbar nerves close to their exits from the vertebral column. Because of the difficulties of paravertebral anesthesia, the infiltration or regional methods are to be preferred in the ordinary hernia operation.

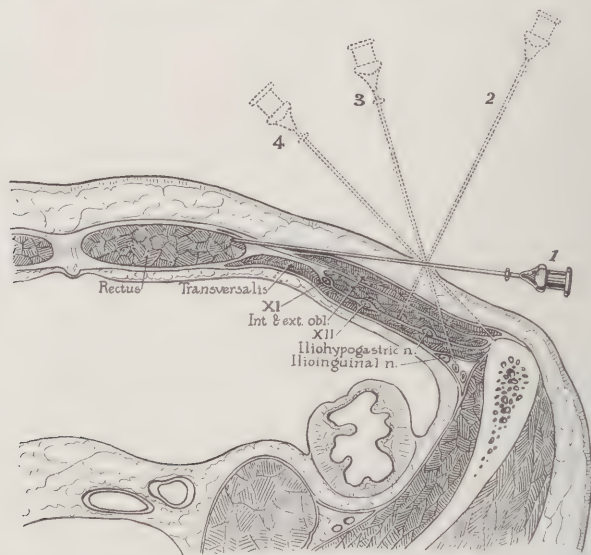


Fig. 64.—Regional anesthesia. Cross section showing the blocking of the last two dorsal, and the iliohypogastric and ilioinguinal nerves.

MODIFIED BASSINI OPERATION

Skin Incision.—A straight incision is made nearly parallel with Poupart's ligament and $\frac{1}{2}$ inch (1.25 cm.) above it, extending from the internal ring to the lower part of the center of the external ring, and in large hernias, to the center of the upper part of the scrotum, just below the external ring. This incision should be 2 to 3 inches (5 to 7.5 cm.) long in children, and 3 to 4 inches (7.5 to 10 cm.) long in adults. (Fig. 65.)

On deepening the incision, the superficial epigastric and superficial circumflex iliac veins are seen crossing the field. These veins should be picked up and divided between hemostats. Some operators prefer to ligate them at once. I do not like to leave catgut ligatures in the fat, and prefer to let the forceps remain until the operation is finished when they can be removed without causing further bleeding, provided the wound is not roughly wiped out with gauze and the terminal clots loosened. (Fig. 66.)

It is sometimes advisable to curve the skin incision over the pubis, instead of downward onto the upper part of the scrotum. With the lower end

of the incision over the pubis, the dressing is more easily kept in place, an important point with infants and children.

The Aponeurosis of the External Oblique.—After freely exposing the aponeurosis, the external ring should be located. If it cannot be seen, it can be found by palpating the cord where it crosses the pubic bone as it



Fig. 65.—Modified Bassini operation. The skin incision is made straight and nearly parallel with Poupart's ligament, and $\frac{1}{2}$ inch (1.25 cm.) above it. It extends from the internal ring to the external ring, or to the center of the upper part of the scrotum in large hernias.

leaves the external ring, and by following the cord upward with a director, or other blunt instrument. If infiltration anesthesia is used, the aponeurosis is exposed and injected at the upper end of the proposed line of incision. (Fig. 67.)

The aponeurosis is now incised in the direction of its fibers from a point

near the internal ring to the external ring, and if the operation is done under infiltration anesthesia, the next step is to locate the ilioinguinal and iliohypogastric nerves and block them as high as possible. (Figs. 68 and 69.) The incision should be made as far from Poupart's ligament as is practical, so as to provide a wide upper flap for overlapping when the wound is closed. It is always advisable to cut through the pillars of the external ring, as this

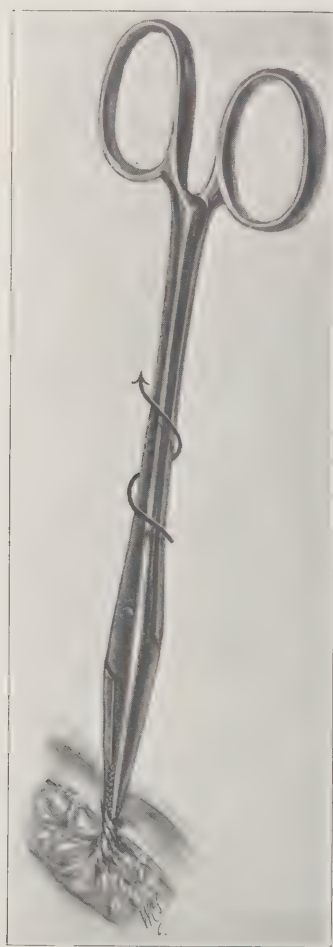


Fig. 66.—Modified Bassini operation. Showing the method of twisting the vessel before removing the hemostat, to avoid the use of unnecessary ligatures.

facilitates resection of the sac and repair of the canal. Some operators prefer to cut the aponeurosis on a grooved director inserted upward through the external ring for a distance of 2 to 3 inches (5 to 7.5 cm.)—a practice to be condemned (Fig. 70), on account of the danger of cutting the ilioinguinal nerve; a better method is to nick the aponeurosis near the internal ring and cautiously divide it in the direction of its fibers until the external ring is reached.



Fig. 67.—Modified Bassini operation. Method of infiltrating the aponeurosis of the external oblique before it is incised.

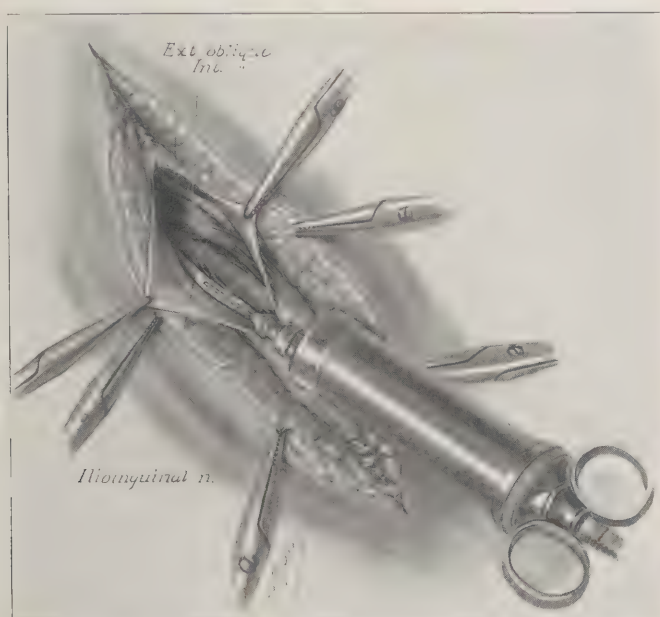


Fig. 68.—Modified Bassini operation. The aponeurosis has been divided, and the iliohypogastric and ilioinguinal nerves exposed. Method of blocking the ilioinguinal nerve in its sheath.

Preservation of the Nerves.—The inguinal branch of the ilioinguinal nerve, the hypogastric branch of the iliohypogastric nerve, and the genital branch of the genitocrural nerve are encountered in the operation for inguinal hernia. The ilioinguinal and iliohypogastric nerves supply motor fibers to the external and internal oblique, transversalis and rectus muscles. The ilioinguinal nerve is frequently found adherent to the under surface of the aponeurosis of the external oblique, about one inch (2.5 cm.) above the external ring. The iliohypogastric, which is the most important nerve, lies 1 to 2 inches (2.5 to 5 cm.) above the ilioinguinal, and is not often injured unless the incision is long. (Fig. 71.)

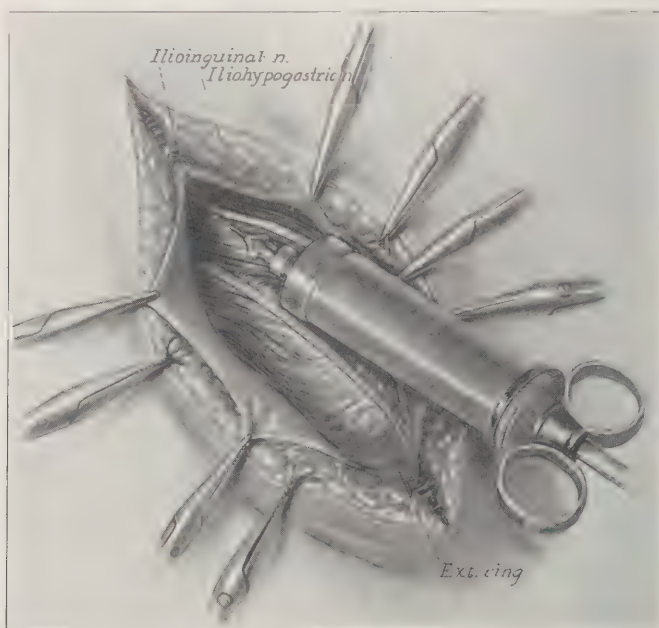


Fig. 69.—Modified Bassini operation. Method of blocking the iliohypogastric nerve in its sheath. Note that the nerve is blocked as high as possible in the incision.

The genital branch of the genitocrural nerve accompanies the spermatic vessels through the inguinal canal and supplies branches to the cremaster muscle. In the female it accompanies the round ligament. The inclusion of one of these nerves in a ligature may result in a troublesome postoperative neuritis. The division of the nerves is followed by atrophy and trophic disturbances in the muscles which predispose to a recurrence.

Attention has been called to the importance of avoiding injury to the iliohypogastric nerve by Morris, Hognet, Dowd, Quain, Moscheowitz and Neuhof, and others. Dowd stated that the most common methods of injury are:

1. Forceful scraping of the internal oblique with scissors, and tearing the nerve from its bed in exposing Poupart's ligament.

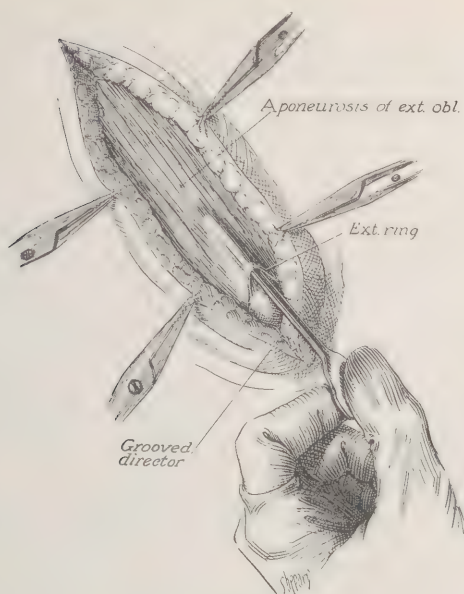


Fig. 70.—The wrong way to divide the aponeurosis. There is danger of dividing the ilioinguinal nerve or its terminal branches. (See the following illustration).

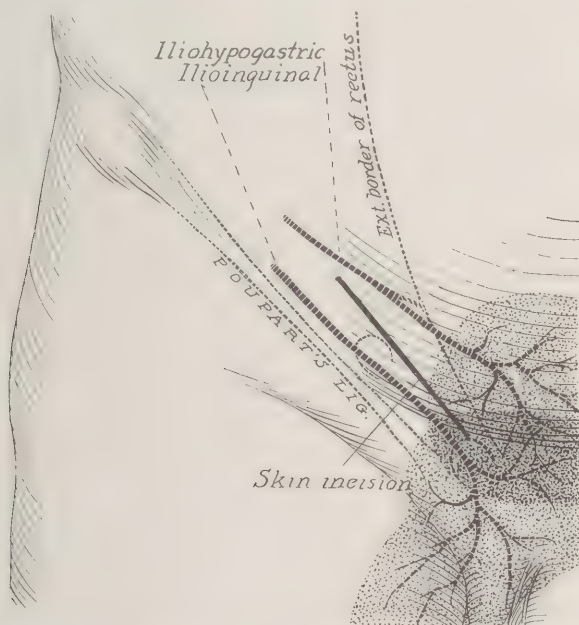


Fig. 71.—The course and distribution of the iliohypogastric and ilioinguinal nerves.

2. Picking up the nerve with forceps and carrying it upward, “out of harm’s way”—this tears away all its branches in this area.

3. Splitting the external oblique from below and accidentally dividing the nerve.

4. Dividing the nerve or including it in a suture just before it enters the aponeurosis of the external oblique. This weakens Hesselbach's triangle. The above methods of injury might apply equally well to the ilioinguinal nerve, although its function is chiefly sensory.

Care must be exercised not to injure the genital branch of the genitocrural nerve. If it is accidentally caught in a ligature, the patient will complain of persistent neuralgic pain in the cord and testis, sometimes for months after operation. If the nerve is divided, the cremaster muscle will atrophy and the testis will hang low in the scrotum, perhaps requiring the patient to wear a suspensory to relieve the dragging pain.

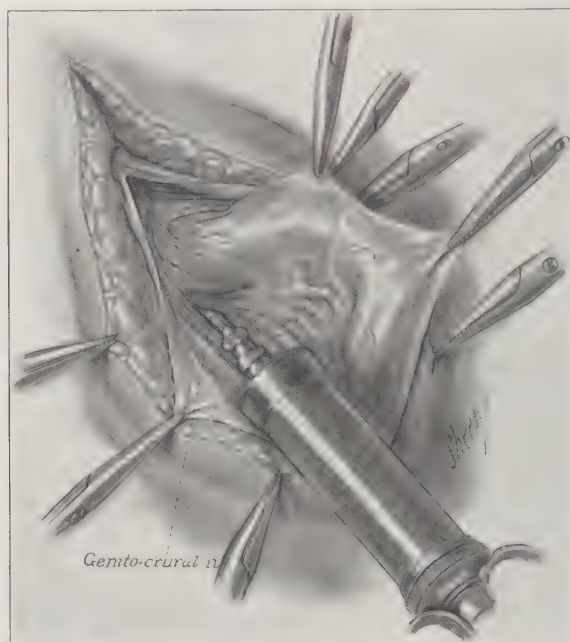


Fig. 72.—Modified Bassini operation. The cord is lifted up, and the genital branch of the genitocrural nerve, which lies behind the cord, is blocked.

Dissection of the Aponeurosis.—The edges of the aponeurosis are retracted. On the inner side, the dissection is continued until the arching fibers of the internal oblique are seen, and in large hernias, the rectus muscle and fascia are exposed; on the outer side, the dissection is continued until the inner shelving margin of Poupart's ligament is well exposed for a distance of 2 to 3 inches (5 to 7.5 cm.) down to the pubic bone. The internal oblique muscle should never be cut. It can always be retracted sufficiently to permit the extirpation of the sac. If the operation is performed under infiltration anesthesia, the genital branch of the genitocrural nerve is blocked after lifting up the cord. (Fig. 72.)

Locating the Sac.—If there is difficulty in locating the sac, it should be looked for in the region of the internal ring where it is easily found. An-

other method is to hook up all the cord structures and the sac on the forefinger. (Fig. 73.)

Freeing the Sac.—The contents of the inguinal canal are grasped with forceps and lifted up at a point just above the external ring, and the cremaster muscle and the cremasteric fascia incised and dissected from the sac and cord. Now, the layer of infundibuliform fascia, which covers the sac and cord, is incised, permitting the sac to be separated easily from the cord. (Fig. 74.)

The spermatic cord can be recognized by feeling the vas deferens and the sac can be identified by the white convex border of the fundus, which is lighter in color than the surrounding tissues. If the cord structures are spread out and examined under a good light, the fundus of the sac can

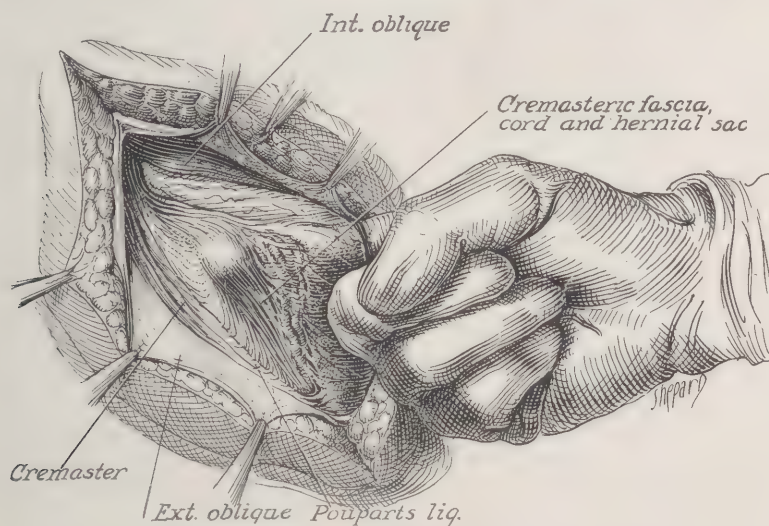


Fig. 73.—Modified Bassini operation. If there is difficulty in locating the sac in the region of the internal ring, where as a rule, it is easily found, the cord structures and sac can be hooked up on the forefinger.

nearly always be distinguished. The difficult cases are the incomplete hernias of recent formation in which the sac is thin, small and empty. The thickened sac walls of old hernias are easily recognized.

In oblique inguinal hernia the sac is almost always found in front of the cord and to the inner side of it. The adhesions between the sac and cord are most dense in the lower part of the inguinal canal; there are few in the upper portion, and here, the sac and cord can be most easily separated. The fundus of the sac is grasped with forceps and separated from the cord. The dissection is continued upward until the narrow part of the neck is passed and the sac begins to widen out and blend with the parietal peritoneum of the abdominal cavity. (Fig. 75.) At this point the peritoneum is whiter, denser, and thinner than the hernial sac. Properitoneal fat will be

found, and if the dissection is high enough the deep epigastric vessels will be seen.

Opening the Sac.—Before opening the sac the contents should be reduced, if possible, and the sac opened very carefully to avoid injury to viscera whose presence in the sac is not suspected. If the sac is empty, it is freed about an inch (2.5 cm.) inside the internal ring. If the hernia is irreducible or if it contains adherent omentum, it is sometimes necessary to open the sac, separate the adhesions and reduce the contents before freeing the sac. Traction on the walls of the sac will usually prevent the protrusion of viscera.

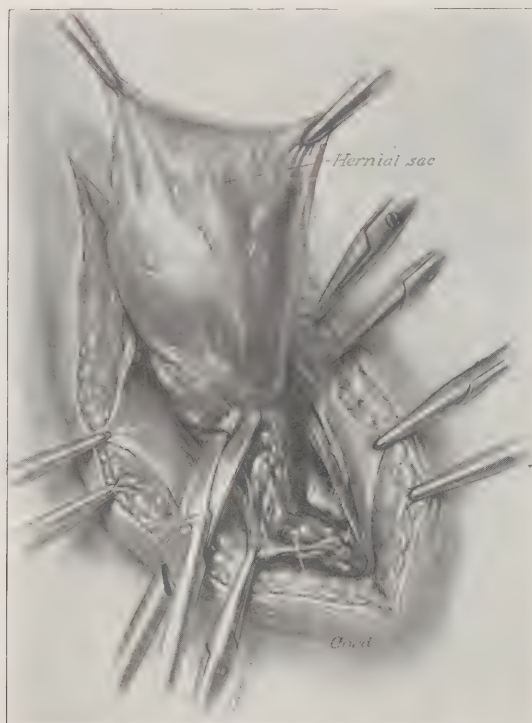


Fig. 74.—Modified Bassini operation. Freeing the sac from the cord structures by sharp dissection.

Omentum in the Sac.—Healthy omentum should be returned to the abdominal cavity. Excision of omentum is indicated in the following conditions: In strangulated hernia; when the omentum cannot be reduced; when the omentum is diseased; and in obese subjects to lessen the intraabdominal tension.

The chief dangers of the excision of the omentum are: Slipping of the ligature with secondary hemorrhage; infection of the portion of omentum lying beyond the ligature; epiploitis; and thrombosis or embolism.

Omental adhesions that are firm and vascular, should be divided between

ligatures. If the intestine or its mesentery is adherent to the sac no attempt should be made to separate them, but the sac trimmed around the adhesions and left attached to the intestine or mesentery. Later the edges are sutured together to cover the raw surfaces so as to prevent the formation of new adhesions.

Method of Ligating Omentum.—When it is necessary to resect omentum, plain catgut should be used for the ligature. The ligating should be done in small sections, a piece of omentum no larger than the little finger being included in each ligature. To prevent slipping, each pedicle of omentum

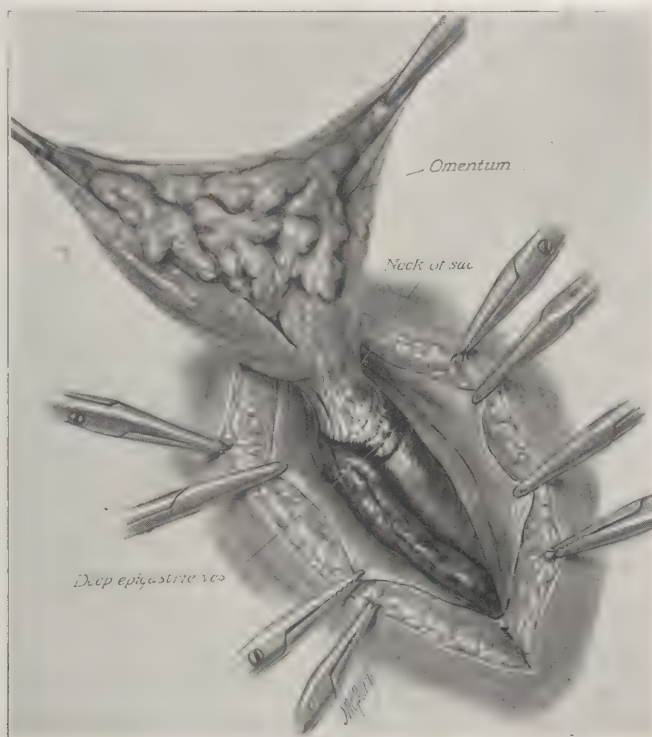


Fig. 75.—Modified Bassini operation. The dissection is continued upward to the internal ring until the narrow part of the sac is passed, and the sac begins to widen out and blend with the parietal peritoneum of the abdominal cavity. If the dissection is high enough the deep epigastric vessels are seen. The sac is opened.

should be transfixed by the ligature before it is tied and the omentum should be cut off $\frac{1}{2}$ inch (1.25 cm.) below the ligature. The Staffordshire (or Tait) knot is used by many surgeons.

When the internal ring is so small that the omentum cannot be reduced, the latter should be ligated in sections with each ligature at a different level, otherwise it may be difficult to return the omental stump to the abdominal cavity. (Fig. 76.)

Disposition of the Sac.—In congenital hernia, if the sac communicates with the tunica vaginalis testis, it cannot be completely removed, as the

fundus is intimately adherent to the testis, and it is necessary to leave a portion of the sac opposite the testis. If too much is left, a secondary hydrocele is liable to form. I usually cut off the sac $\frac{1}{3}$ to $\frac{1}{2}$ inch (1 to 1.25 cm.) from the testis, all around. I have seen necrosis of the testis follow an operation in which the surgeon attempted to strip the tunica vaginalis from the testis.



Fig. 76.—Modified Bassini operation. Healthy omentum is returned to the abdominal cavity. Irreducible or diseased omentum should be ligated in small sections to lessen the danger of embolism. When the internal ring is small, each ligature is applied at a different level; otherwise it may be difficult to return the omental stump to the abdominal cavity.

Ligation of the Sac.—When operating under local anesthesia it is a good plan to inject the neck of the sac before transfixing and ligating it. (Figs. 77 and 78.) In small hernias traction is made on the sac, and a transfixing ligature of plain catgut is passed through the neck of the sac well within the internal ring. Before the ligature is tied, the sac should be pulled down and held open for inspection to make sure that no omentum, intestine or

bladder is caught in the ligature, which is now tied high up, while traction is made on the sac. If the neck of the sac is large, a pursestring suture is often more satisfactory than a simple ligature. If the sac is ligated high enough, there will be a good spring back of the stump, which will be drawn up inside the internal ring by the elasticity of the peritoneum. (Fig. 79.)

If any portion of the sac is left behind, due to the dissection not extending high enough, or to faulty ligation, a funnel-shaped process of peritoneum will be left and the hernia is liable to recur. The object is to reconstruct the depression of peritoneum between the plica urachii and the plica hypogastrica—the internal inguinal fossa—and to obliterate the funnel-shaped opening leading to the sac.

When the neck of the sac is very wide, and especially if the bladder is involved in the posterior wall or can be pulled down by making traction on the sac, I have found it a good plan to cut the sac transversely and close it

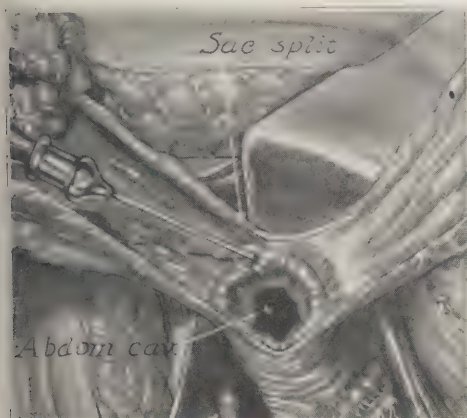


Fig. 77.

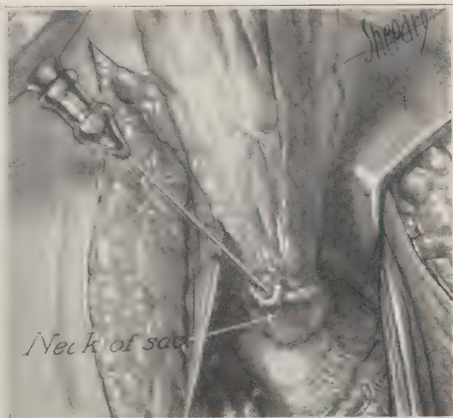


Fig. 78.

Modified Bassini operation. Anesthetizing the neck of the sac.

Fig. 77.—Opening the sac and blocking the parietal peritoneum beyond the internal ring.

Fig. 78.—Infiltrating the neck of the empty sac without opening it.

by interrupted or continuous sutures, as in any other peritoneal wound. Sometimes it is advisable to place a second row of sutures in the peritoneum to lessen the tension on the first row and prevent it from giving way.

Accidents to be Avoided During Ligation.—The dangers to be borne in mind during ligation are: Accidental puncture of the bladder or the epigastric vessels with the ligature needle; the transfixion of omentum or intestine with the ligature needle; the inclusion of omentum, intestine, or vas deferens in the ligature of the sac.

Leaving the Scrotal Portion of the Sac in Situ.—In large scrotal hernias, when dissection of the sac is difficult and tedious and the patient's condition calls for a speedy operation, there is no particular harm in dividing the sac below the neck and leaving the scrotal portion. In these cases I

often turn down a tongue from the wall of the sac, paint the inner surface with iodine, suture the tongue to the bottom of the sac, and occlude the walls with a continuous suture.

Dehelly treated the serotal portion of the sac as follows: The sac is



Fig. 79.—Modified Bassini operation. Ligation of the sac. In small hernias traction is made on the sac, and a transfixing ligature or a pursestring suture is passed through the neck of the sac well within the internal ring. If the sac is excised high enough there will be a good “spring-back” of the stump, which will be drawn up inside the internal ring by the elasticity of the peritoneum.

(Insert shows closure of a large hernial sac stump by a continuous suture of the peritoneum.)

divided below the ligature, split parallel to the cord, everted and wrapped around the cord, and held in position by interrupted sutures. Similar operations were described by Taddei and by Neuberger.

The Deep Sutures.—The most important step of the operation is the suturing of the arching fibers of the internal oblique and the conjoined tendon to the inner shelving margin of Poupart's ligament. These structures form the new floor for the inguinal canal. The cord should be handled as little as possible. It should be retracted by an instrument that does not compress it, rather than by the common practice of passing a strip of gauze beneath it, which may cause torsion of the cord when the latter is replaced in the internal ring next to the peritoneum. Traumatism of the cord is responsible for most of the after-pain, as well as the occurrence of epididymitis, orchitis, and rarely, thrombosis and embolism. (Fig. 80.)

With the cord gently retracted to one side, the first stitch is taken at the upper end of the inguinal canal in the following manner: A round-pointed full curved needle, threaded with chromic catgut, is passed through the internal oblique and transversalis muscles, and if possible, through the transversalis fascia also, which forms the internal ring proper. Bassini, who first

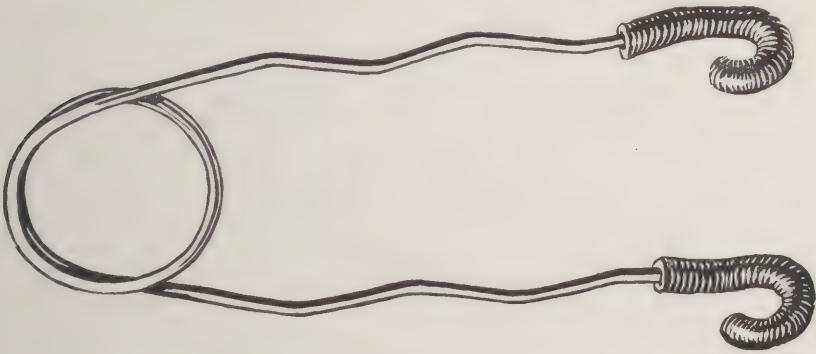


Fig. 80.—The author's cord retractor. The points of the retractor are covered with rubber tubing.

emphasized the importance of this stitch, pushed a small flat director into the internal ring next to the peritoneum, and lifted up all the structures excepting the peritoneum, to make sure that the transversalis fascia was caught in the bite. Next, the needle passes outward through the cremaster muscle and finally through the inner shelving edge of Poupart's ligament. This suture should be inserted sufficiently high to touch the lower border of the uplifted cord, and should not be tied until the rest of the deep sutures have been placed. Three to five deep sutures are usually required and are placed $\frac{1}{3}$ of an inch (8 mm.) apart. The two or three upper ones should take a bite in the cremaster muscles, as suggested by Brenner and Halsted, while the two lower ones approximate the conjoined tendon to Poupart's ligament, and in large hernias to Gimbernat's ligament also. The lowest suture is one of the most important, and Bassini always inserted this one first. I prefer to pass this suture as follows:

The external oblique muscle is retracted inward and the ilioinguinal nerve,

which has been retracted to the inner side, is released and permitted to drop back into its normal position. The needle is passed through the reflected portion of the external oblique, one-third of an inch (8 mm.) above the point where the muscle meets the conjoined tendon. It crosses over the nerve and picks up the outer portion of the conjoined tendon, and then passes beneath the cord and enters the lower part of Poupart's ligament close to its attachment to the pubic spine, and often includes a bite in the periosteum. This stitch does not compress the ilioinguinal nerve; if it were to do so, it would cause postoperative neuralgic pain or neuritis. (Fig. 81.)

In order to make the opening as small as possible, all fat and other tissue should be dissected away from the cord and nothing allowed to remain but the vas deferens, artery, nerve and veins. After the deep sutures are tied, a stitch is placed above the cord, as recommended by Coley, and passed

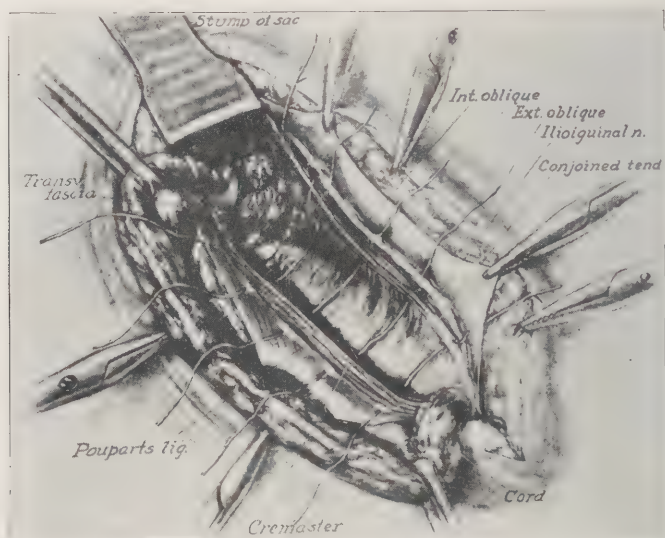


Fig. 81.—Modified Bassini operation. Method of passing the deep sutures. (See text for detailed description).

through the upper part of the internal ring to narrow the ring and strengthen it, thus lessening the danger of recurrence. The internal ring should be closed as snugly as possible around the cord, there being little danger of getting it too tight. If there is any question on this point, however, the pulsation in the spermatic artery may be felt. Bassini placed a small director in the ring before tying the suture and removed it when the suture was tied; in this way there is no danger of getting the stitch too tight.

Care must be exercised to take a good bite in the conjoined tendon; to catch the inner shelving edge of Poupart's ligament and not the free cut edge of the aponeurosis of the external oblique; to avoid tying the sutures too tightly; and to guard against puncturing the deep epigastric and external iliac vessels.

Flexion of the Thigh to Facilitate Approximation of the Deep Sutures.

—The best exposure of the field of operation is obtained by keeping the thigh extended until the deep sutures are ready to be tied, when it should be elevated and adducted. This reduces the distance between Poupart's ligament, the internal oblique and the conjoined tendon from 25 to 50 per cent, depending on the size of the opening and the development of the muscles, and the suture can be tied without tension, even in large hernias. Newman pointed out the value of this procedure, and Lyle found in studying a series of hernia operations, that the distance between Poupart's ligament and the conjoined tendon could be reduced 20 to 70 per cent by flexing the thigh.

Closing the Aponeurosis of the External Oblique.—The cord is replaced on its new floor, which is formed by the internal oblique and conjoined tendon. The cut edges of the aponeurosis are freed from fatty connective



Fig. 82.—Modified Bassini operation. The cord is replaced on its new bed, formed by the internal oblique and conjoined tendon. The flaps of aponeurosis are overlapped from above downward in a double-breasted fashion, to strengthen the aponeurotic covering and to take some of the strain off the deep sutures.

tissue and sutured together from above downward by a continuous suture of chromic catgut, leaving just enough room in the new external ring for the cord. The flaps of aponeurosis are overlapped from above downward in a double-breasted fashion to strengthen the aponeurotic covering of the new inguinal canal and to take the strain off of the deep sutures. (Fig. 82.) The fat is brought together by a running suture of fine plain catgut and the skin closed by a continuous subcuticular stitch and without drainage. (Figs. 83 and 84.)

Suture Material.—Kangaroo tendon was first used by Marey in 1870, for the deep sutures in hernia operations. Many surgeons continue to use

it in preference to chromic catgut, as the tendon has the advantage of being absorbed more slowly. Catgut is more easily obtained than kangaroo tendon, and comes in longer lengths, and for this reason it is more generally used. Plain catgut No. 2 is being used in some clinics for the deep sutures and the results seem to be just as good as when the less absorbable materials are employed.

Inguinal Hernia Operation in the Female.—It is easier to cure inguinal hernia in the female than in the male, because there is no cord to prevent complete closure of the internal ring and the inguinal canal. I prefer to leave the round ligament undisturbed and include it in the deep sutures.

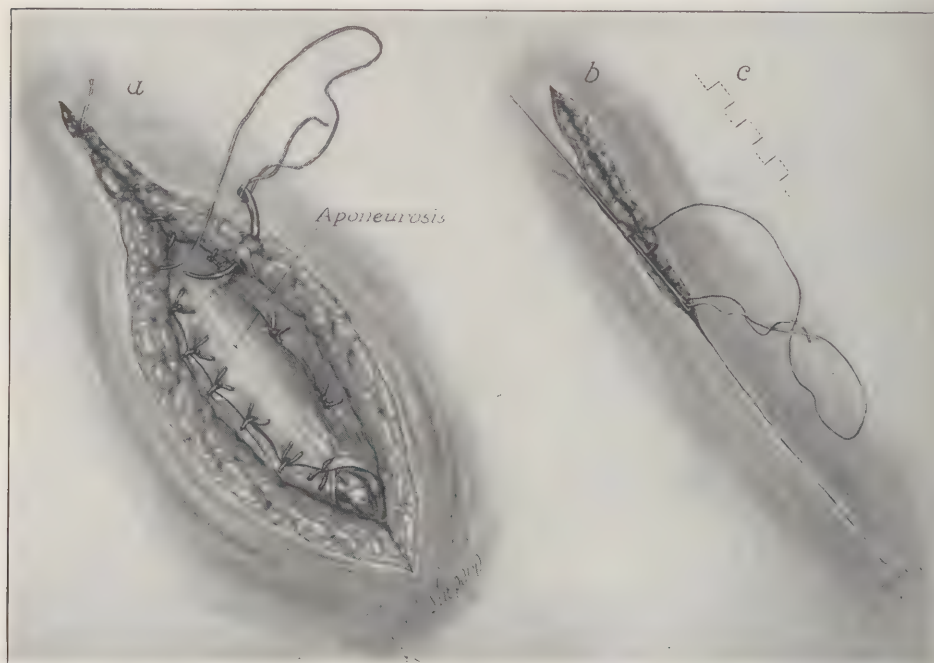


Fig. 83.—Modified Bassini operation. The overlapping of the aponeurotic flaps is completed. (a) The subcutaneous fat is brought together by a running suture of fine plain catgut. (b) The skin wound is closed by a continuous subcuticular suture, without drainage. (c) Schema of the subcuticular suture.

Lucas-Championnière removed the sac, excised the round ligament and overlapped the flaps of aponeurosis. Kelly transplanted the round ligament and did not remove the sac if it was small. (I might remark here that hydrocele of the canal of Nuck is sometimes difficult to distinguish from hernia.)

Method of Removing Very Adherent Sac.—Schoenberg observed that when it is difficult to remove the sac, the dissection can be facilitated by filling the sac with strips of gauze to outline its walls.

Position of the Patient after Operation.—After the deep sutures are placed, the wound is kept relaxed by elevating the shoulders and flexing

the thigh. This position, which I have found especially valuable in direct and large recurrent hernias, should be maintained as long as the patient is kept in bed.

Halsted's Operation.—1. *Oblique Hernia.*—In 1889 Halsted described an operation in which he featured the narrowing of the cord by excision of some of the veins, the suturing of the internal oblique to Poupart's ligament, and subcutaneous transplantation of the cord. In 1903 he stated that he no longer excised the veins of the cord or transplanted the cord.

At the present time, the technic of the Halsted operation is as follows: The skin and aponeurosis are incised as in the modified Bassini operation, the flaps of aponeurosis dissected back, exposing the conjoined tendon and

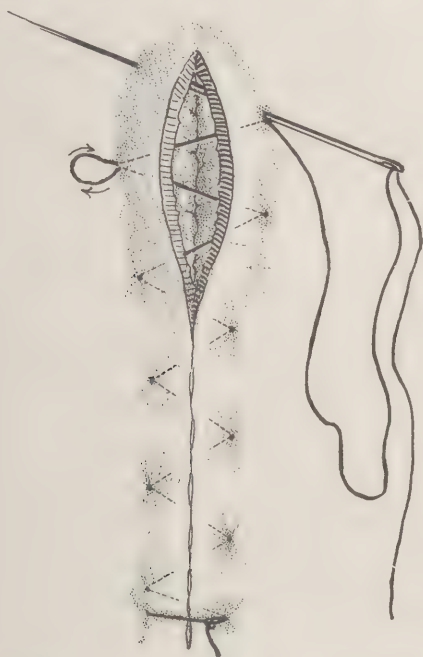


Fig. 84.—A simple and quick method of subcuticular skin suture.

internal oblique muscle, and the cremaster muscle incised longitudinally. The sac is opened and separated from the cord by sharp dissection, freed to the internal ring, twisted, transfixied by a ligature, tied and excised. (Taylor, A. S.)

The important point in the operation, as pointed out by Brenner and by Halsted, is the utilization of the cremaster muscle and fascia. Mattress sutures are passed through the conjoined tendon, internal oblique, cremaster muscle and fascia, then back through the conjoined tendon and internal oblique and tied. The cremaster should be drawn up under the conjoined tendon and internal oblique, without tension on the sutures. The cord is left undisturbed. Next, the edge of the conjoined tendon and the edge of

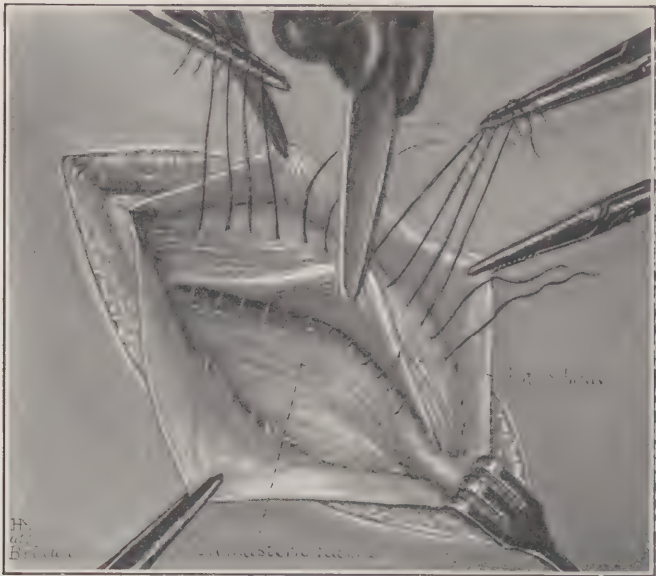


Fig. 85.—Halsted's operation for oblique inguinal hernia. The operation up to the point of closure is similar to that already described. Mattress sutures are passed through the conjoined tendon, internal oblique, cremaster muscle and fascia, then back through the conjoined tendon and internal oblique, and tied. The important step in this operation is the utilization of the cremaster muscle and fascia. The cord is not disturbed.

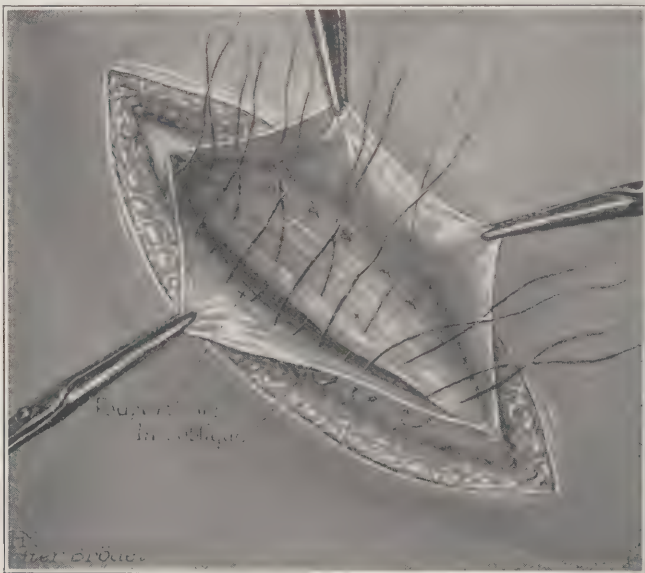


Fig. 86.—Halsted's operation for oblique inguinal hernia. The edge of the conjoined tendon and the edge of the internal oblique are sutured to Poupart's ligament.

the internal oblique are sutured to Poupart's ligament. The flaps of aponeurosis of the external oblique are overlapped, the edge of the upper flap stitched to the outer surface of the conjoined tendon and the internal oblique.

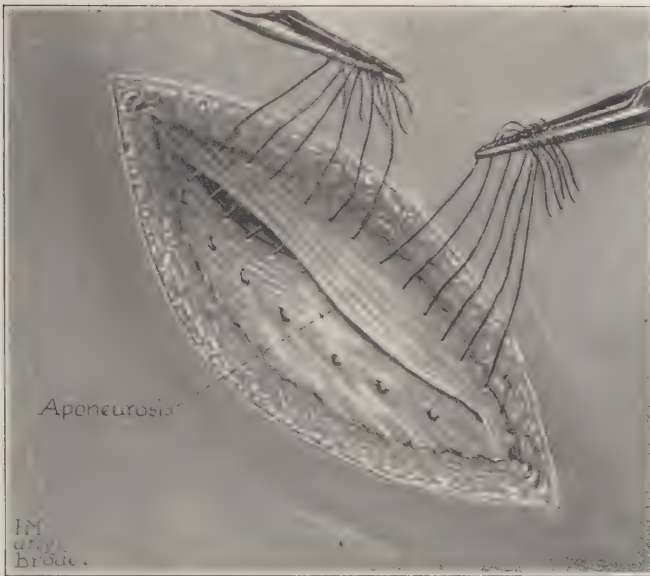


Fig. 87.—Halsted's operation for oblique inguinal hernia. The flaps of aponeurosis are overlapped from above downward and sutured.

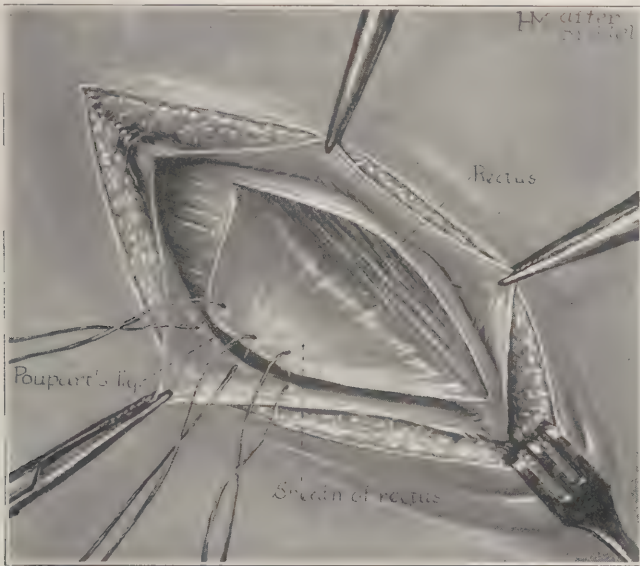


Fig. 88.—Halsted's operation for direct inguinal hernia. A triangular flap, secured from the anterior sheath of the rectus, is turned down and sutured to Poupart's ligament.

the lower flap is brought down and sewed to the outer flap and the superficial fascia and skin are closed. (Figs. 85, 86, and 87.)

2. *Direct Hernia*.—In direct hernias the cord is sometimes transplanted. If the conjoint tendon is deficient, a triangular flap of fascia is transplanted from the anterior rectus sheath and used to cover the gap. (Fig. 88.)

Halsted has discontinued the excision of veins in the cord. Although this step lessened the percentage of recurrences, hydrocele developed in 20 per cent of the cases, while it occurred only in 4 per cent of the cases in which the veins were not excised. I want to call attention to the importance of including the cremaster muscle in the deep sutures to strengthen the suture line, especially in the repair of direct hernia.

Brenner's Operation.—Brenner modified the Bassini operation by using the cremaster muscle to reenforce the internal oblique and conjoined tendon in reconstructing the floor of the inguinal canal. Noetzel stated that it is often advisable to reenforce the suture line by separating the cremaster at its lower end and stitching it into the inner lower angle of the hernial opening. If a gap still remained, he turned down a flap of the internal oblique with its aponeurosis to cover the opening, and thus secured a firm posterior wall for the new inguinal canal.

Andrews' Operation.—In 1895 Andrews described an operation that is steadily becoming more popular, in which the important feature in the technique is the imbrication of the aponeurosis of the external oblique. Up to this point the operation is similar to the modified Bassini operation.

There are two methods of overlapping or imbrication:

a. *The Anterior Method*, in which the overlapping is in front of the cord, can be used with any operation where the cord is not transplanted, such as the Halsted or Ferguson methods. Two to five deep sutures unite the internal oblique muscle, conjoined tendon and the upper flap of the aponeurosis of the external oblique to Poupart's ligament over the cord. The lower edge of the aponeurosis is overlapped for at least an inch (2.5 cm.) over the upper flap and fastened with a running suture.

b. *The Posterior Method* is applicable to operations which transplant the cord, such as the Bassini operation. The cord is lifted up and the internal oblique, conjoined tendon and upper flap of the aponeurosis sutured to Poupart's ligament. The cord is replaced on its new bed, formed by the aponeurosis of the external oblique, and the lower flap of aponeurosis is lapped over it at least an inch (2.5 cm.) and sutured to the upper flap with a running stitch. (Figs. 89 and 90.)

Werelius noticed that when the sutures of the overlapped flaps were tied they did not always approximate. To overcome this, he raised the lower flap, and by means of a running suture beginning at the pubic end, united the inner surface of the lower flap to the outer surface of the upper flap. On reaching the upper end of the incision, the same suture was used to fasten the edge of the lower flap to the outer surface of the upper flap.

Girard in 1898, Fournel in 1900, and Neuffer in 1922, described operations similar to the Andrews' operation. Girard divided the aponeurosis of the external oblique so as to leave a strip of it the width of a finger along Poupart's ligament to form the lower flap, which was lapped over the upper one, after the latter had been stitched to Poupart's ligament.

Payne overlapped the flaps of aponeurosis from below upward, to lessen the tension on the deep sutures. A similar operation was described by Chatterjee. Fobes described an operation similar to Andrews' posterior imbrication, with the exception that he united the internal oblique and conjoint tendon to Poupart's ligament, and reenforced this suture line by sewing the upper flap of aponeurosis to Poupart's ligament. The lower flap of aponeu-

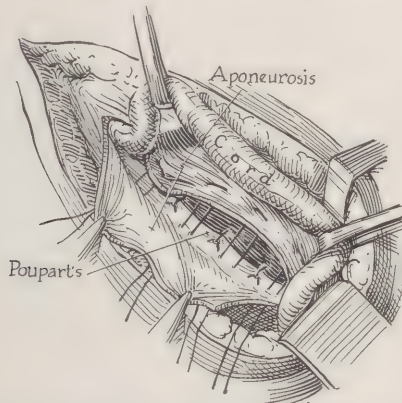


Fig. 89.—Andrews' operation. The cord is lifted up and the internal oblique, conjoint tendon and upper flap of the aponeurosis sutured to Poupart's ligament. The cord is replaced on its new bed, formed by the aponeurosis.

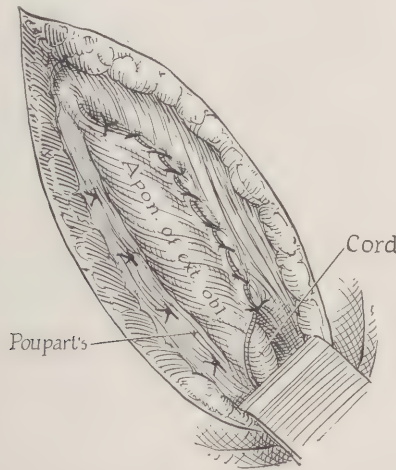


Fig. 90.—Andrews' operation. The lower flap of aponeurosis is lapped over the upper flap at least an inch (2.5 cm.), and sutured to it with a continuous or interrupted stitch.

rosis is lapped over the cord and stitched to the upper flap, as in the Andrews operation.

Mann's Operation.—Mann described an operation which is similar to the Bassini operation up to the point where the aponeurosis of the external oblique is closed: He formed a bed for the cord under the upper flap of the aponeurosis of the external oblique by separating, with the finger, its attachment to the internal oblique. The lower flap of aponeurosis of the external

oblique is folded upward over the cord at the level of the internal ring, and its inner edge drawn under the cord and fastened to the sheath of the rectus muscle, well beyond the usual location of the internal ring. This reenforces the external ring, the internal ring, and the deep suture line with a layer of aponeurosis of the external oblique. The lower flap is sutured along the cord from the internal ring to the edge of the flap. The operation is completed by bringing the upper flap down over the cord and suturing it to Poupart's ligament. The new external ring is reenforced behind by the

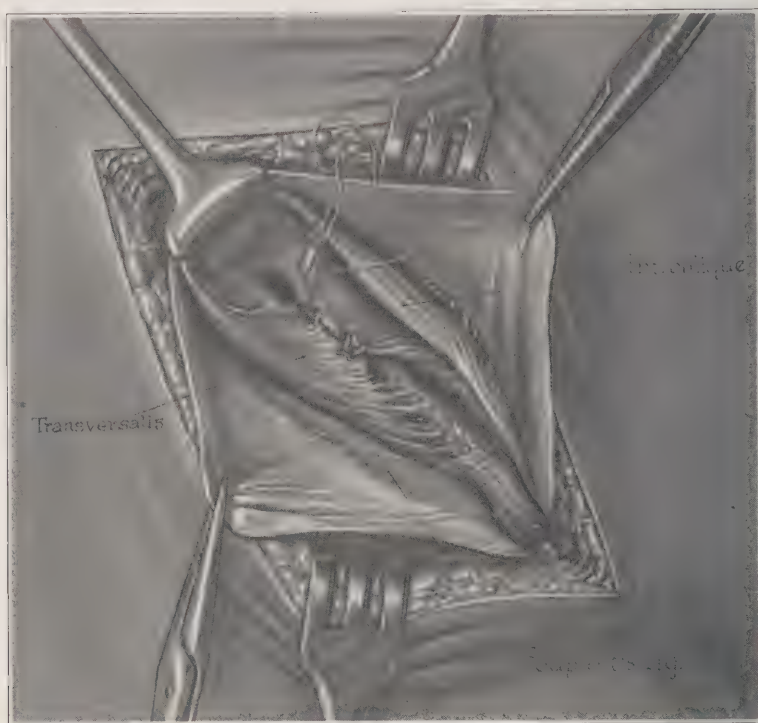


Fig. 91.—Ferguson's operation for oblique inguinal hernia. The operation up to the point of closure is the same as the modified Bassini operation. The cord is left undisturbed and the internal ring, which consists of transversalis fascia, is narrowed by catgut sutures.

lower flap of aponeurosis of the external oblique, which obliterates the old external ring.

Ferguson's Operation.—Ferguson believed the cause of hernia was a deficiency of the internal oblique and transversalis muscles at Poupart's ligament, and in 1899 he devised the following operation to correct this condition, a similar one having been described by Bull and Coley in 1892, and by Girard in 1900:

The skin incision is begun over Poupart's ligament one and one-half inches (3.75 cm.) below the anterior superior iliac spine and continued downward and inward terminating over the conjoined tendon near the pubic

bone. The flap is turned down and the aponeurosis of the external oblique exposed. The external ring and the intercolumar fascia are incised. The longitudinal fibers of the aponeurosis of the external oblique are separated from the internal oblique muscle over the inguinal canal, up to a point above the internal ring and outward to a position opposite the anterior superior iliac spine. The edges of the aponeurosis are retracted to expose the contents of the inguinal canal and any deficiency in the origin of the internal oblique at Poupart's ligament. The sac is freed from the cord up to the internal ring and dealt with as described under the modified Bassini operation.

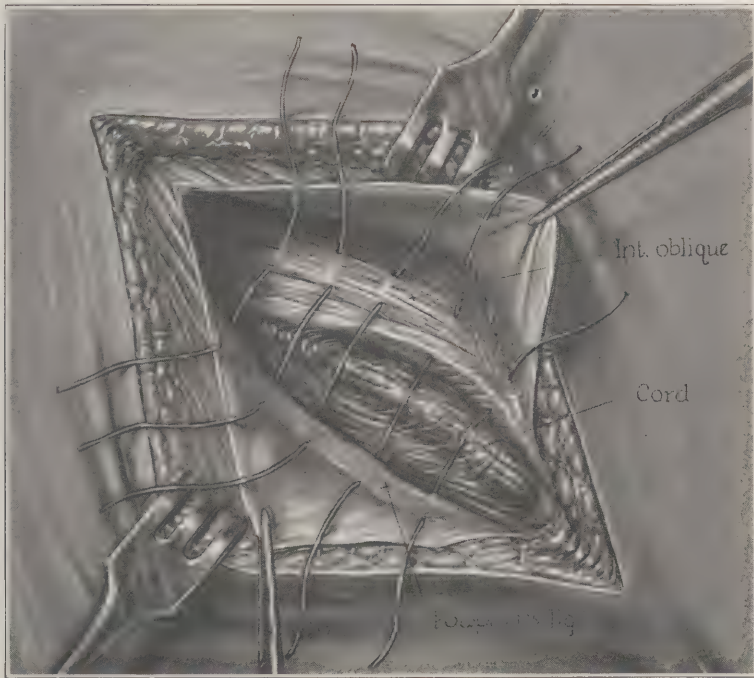


Fig. 92.—Ferguson's operation for oblique inguinal hernia. The internal oblique and transversalis muscles are stitched to the shelving edge of Poupart's ligament. The aponeurotic flaps are overlapped and sutured, and the external ring restored. The subcutaneous tissues and skin are closed in the usual manner.

tion. The cord is left undisturbed, and the internal ring, which consists of transversalis fascia, is narrowed by catgut sutures. The internal oblique and transversalis muscles are stitched to the shelving edge of Poupart's ligament, the sutures extending two-thirds of the way down, or farther. The edges of the aponeurosis of the external oblique are overlapped and sutured and the external ring restored. The subcutaneous tissues and the skin are closed in the usual manner. (Figs. 91 and 92.)

Direct Hernia.—If there is also a direct hernia, or if the conjoint tendon is deficient or absent, the rectus sheath is opened down to the pubic bone and the rectus muscle drawn down and sutured to Poupart's ligament.

Scudder's Operation.—The principal features of Scudder's operation are: The suturing of the neck of the sac instead of ligating it; placing two sutures above the cord, as advocated by Coley; suturing the internal oblique and conjoined tendon along with the cremaster muscle to Poupart's ligament; and overlapping the edges of the aponeurosis of the external oblique.

Torek's Operation.—Torek described an operation in which the coverings are dissected from the spermatic cord until it consists only of the vas deferens and the vessels. These are separated, and the cord divided into two parts. The blood vessels are brought out at the upper end of the wound and the vas deferens at the middle; or the blood vessels may come through at the center and the vas deferens at the lower end of the deep sutures. Torek separated the two portions of the cord so that two sutures were between them. The rest of the operation is the same as the Bassini already described. If there is difficulty in narrowing the internal ring this technic is a valuable one.

Lateral Displacement of the Cord.—The operation I am about to describe is the regular Bassini operation with an additional step in technic. Everybody knows that if recurrence does follow the Bassini operation, it almost always takes place either at the internal ring, at the lower end of the incision over the pubic bone, or in the line of deep sutures. The procedure that I employ reenforces these weak spots. I have used it since 1916 in suitable cases, and it has given a lower percentage of recurrence than the original Bassini operation:

The Bassini operation is followed up to the point where the cord is transplanted. The cord is made as small as possible by removing all of its coverings, leaving only the vas deferens and the spermatic vessels. The upper flap of the aponeurosis is freed from the internal oblique as far as the outer border of the rectus muscle.

The cord is placed on the internal oblique $\frac{1}{2}$ to 1 inch (1.25 to 2.5 cm.) internal to the deep suture line, the exact distance depending on the length of the cord, and retained in this position by one or two interrupted sutures. These sutures are inserted external to the cord, internal to the deep suture line, and they unite the inner surface of the aponeurosis to the internal oblique and conjoined tendon. (Fig. 93.)

Sometimes it is advisable to place an additional stitch internal to the internal ring just above the cord, and I often suture the aponeurosis to the deep suture line as high as the lower edge of the internal ring. The flaps of aponeurosis are overlapped by bringing the edge of the upper flap down and stitching it to the under surface of the lower flap, which is then turned up and tacked to the upper flap.

This method of closure reenforces the internal ring by changing the angle of the cord as it leaves the ring, and by getting the cord away from the deep suture line; it places a strong double-breasted barrier of aponeurosis directly over the internal ring and the deep suture line; it permits firm

union between the muscles and the aponeurosis along the deep suture line, so that the internal ring and the line of deep sutures, the usual points of recurrence following the Bassini operation, are doubly reenforced.

There is no danger of getting the sutures tight enough to cause pressure on the cord, in spite of the increased length of the canal, because the floor of the canal is formed entirely by muscle and no pressure is exerted on the cord from the inner side.

This operation cannot be used when the spermatic cord is abnormally short, as in hernias associated with mal descended or undescended testes, or in recurrent hernias when the aponeurosis of the external oblique is deficient or has been replaced by scar tissue. When the internal oblique is deficient, the reenforcing sutures unite the aponeurosis to the cremaster and the transversalis muscles. If the cord is divided in two parts, as in Torek's

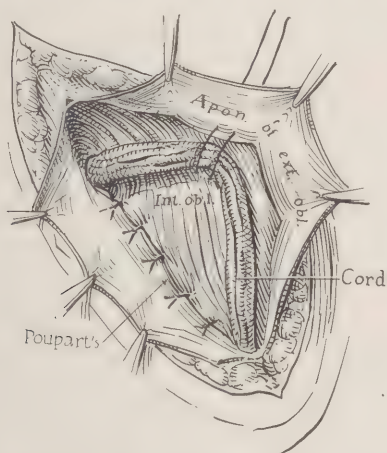


Fig. 93.—Inguinal hernia operation. The author's method of displacing the cord to get it away from the suture line, thus lessening the danger of recurrence.

operation, the two portions are placed internal to the deep suture line and separated by one or two reenforcing sutures.

La Roque's Operation.—La Roque described an operation which opens the peritoneal cavity well above the hernia. This incision gives an excellent exposure of the vas deferens and bladder assuring a high removal of the sac. The usual Bassini incision is made and the hernial sac and cord exposed. The fibers of the internal oblique and transversalis muscles are separated an inch (2.5 cm.) above their lower margins, and the peritoneum opened above the neck of the sac. If the muscles are thinned they may be retracted upward and the peritoneum opened above the neck of the sac. The hernial contents are examined and dealt with from the abdominal side. A finger is passed into the sac to aid in freeing it up to a point within the internal ring. A forceps is inserted in the sac, and the lowest portion of the sac grasped and inverted into the abdominal cavity. The sac and redundant peritoneum

are pulled upward and sutures passed through the peritoneum an inch (2.5 cm.) above the internal ring, which is completely obliterated. Each of these sutures takes a bite in the original peritoneal incision. The sac is excised and the split muscle fibers sutured together. The inguinal canal is closed in the usual manner, with or without transplanting the cord, and the superficial fascia and skin sutured. (Fig. 94.)

Division of the Internal Ring to Expose the Sac.—Davies suggested the following operation to simplify finding the sac and freeing it: After the usual incision down to the cord, the internal oblique is retracted upward and the peritoneum above the sac is opened by an incision extending upward from the internal ring. With the abdominal cavity opened, the neck of the sac is easily seen, the contents reduced, the incision carried around the neck of the sac, the abdominal peritoneum incised and the opening closed with a

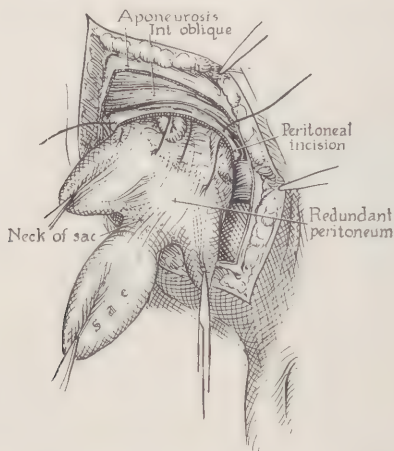


Fig. 94.—Inguinal hernia. La Roque's operation opens the peritoneal cavity well above the hernia, deals with the sac contents, inverts the sac into the abdominal cavity, ligates and excises the sac, sutures the split muscle fibers and closes the inguinal canal in the usual manner.

continuous suture. The sac is removed, leaving the cord undisturbed, the deep sutures are placed and the subcutaneous tissues and skin closed.

White (J. M.) incised the internal oblique above the internal ring and constructed a new ring for the cord, which was reenforced by suturing a strip of the aponeurosis of the external oblique to the internal oblique just below the exit of the cord.

Hull's Operation.—Hull described an operation which removes the sac high, and causes very little disturbance to the cord or other tissues: An oblique skin incision $\frac{1}{2}$ inch (1.25 cm.) above Poupart's ligament exposes the part of the aponeurosis that lies directly over the cord. The fibers of the aponeurosis are split for a distance of $\frac{1}{2}$ inch (1.25 cm.) exposing the cremaster and fascial coverings of the cord, which are drawn through this aperture. The cremaster fibers are separated and the fascia incised down to the sac. The sac is picked up with two hemostats and opened between

them. Two more forceps are applied to the edges of the opening, thoroughly exposing the interior of the sac with its two openings, one toward the abdomen, the other into the scrotum. The ridge of peritoneum (the crista), which separates the two openings, is picked up and the transverse division of the sac completed. The neck of the sac is separated from the surrounding tissues as high up as possible, transfixcd with a catgut suture, ligated, the sac excised, and the stump allowed to retract within the abdomen.

The skin incision is closed with a stitch passing down to the aponeurosis and including it. Hull employs silkworm gut for this suture; he stated that this operation is all that is required in 90 per cent of inguinal hernias. If the internal ring is large, the conjoined tendon is drawn down over the cord and sutured to Poupart's ligament. A similar operation has been described by Taylor (E. H.).

Closing the Internal Ring.—Bates used an oblique skin incision about 2 inches (5 cm.) long over the internal ring. The external oblique is separated, the arching fibers of the internal oblique retracted, and the transversalis fascia and peritoneum opened. The sac is freed, ligated and excised. The internal ring is drawn up into the wound and a pursestring suture passed around the circumference of the ring through the transversalis fascia; except at the lower and inner part where it passes over the cord or the round ligament. The ligature is tied, and used as a suture which is passed from within outward through the parietal peritoneum and through some of the fibers of the internal oblique. Then it is reversed, and passed from without inward through the muscle and peritoneum of the opposite side of the incision, where it is tied to the free end of the pursestring. The next stitch is passed through the peritoneum and the upper part of the new internal ring. When this stitch is drawn tight, it holds the internal ring firmly against the parietal peritoneum. The suture is then used as a running stitch to close the remainder of the peritoneal incision, and the wound is closed in the usual manner.

Slattery believed that the importance of repairing the defect in the transversalis fascia is not generally appreciated. He emphasized the necessity of restoring the fascial internal ring and placing it under the supporting fibers of the internal oblique. Kirby closed the internal ring and restored its slit-like form in the following manner: The transversalis fascia that lies below and internal to the cord is drawn upward by interrupted sutures to a point behind the anterior portion of the internal ring.

Fowler's Operation.—Fowler's operation is similar to the Bassini operation up to the point where the sac is freed at the internal ring. The sac is cut off, its edges grasped by forceps, and the deep epigastric artery and vein are divided between ligatures. With a finger in the abdominal cavity as a guide, the floor of the canal is divided and the cord placed in the peritoneal cavity. The incision in the floor is sutured and the cord brought out at the lower end, so that it curves upward and forward as it leaves the

abdomen. The inguinal canal, the incision in the aponeurosis of the external oblique, and the skin wound are closed.

Ferrari incised the transversalis fascia, placed the cord behind it, and sutured the transversalis muscle and fascia along with the internal oblique and conjoined tendon to Poupart's ligament. The aponeurosis of the external oblique is then sutured together. Similar operations were described by Parona, Reclus, Millot, and Soubeyran.

Mugnai closed the internal ring and sutured the transversalis fascia, internal oblique, and conjoined tendon to Poupart's ligament in front of the cord, which comes out between the two lowest sutures at the external ring. Aguilar, and Bégouin advocated this method.

Placing the Cord Superficial to the Aponeurosis of the External Oblique (Obliterating the Inguinal Canal).—A number of operations have been devised to close the external ring; most of these bring the cord out at the upper end of the incision, and allow it to rest on the aponeurosis.

In the original Halsted operation the cord is placed superficial to the aponeurosis of the external oblique, and comes out through a new internal ring 1 inch (2.5 cm.) above the old one. In this operation, as well as in those proposed by Postempski and O'Connor, the aponeurosis is not overlapped.

Postempski obliterated the inguinal canal by lifting up the cord and suturing the internal oblique, conjoined tendon, and aponeurosis of the external oblique to Poupart's ligament. He placed the cord subcutaneously and closed the external ring. A similar operation was devised by O'Connor.

Finochietto and Squirru described a modification of the Postempski operation in which the wound is closed in three layers instead of in two. The upper flap of aponeurosis together with the edge of the internal oblique is sutured to Poupart's ligament.

Woolsey and Swift sutured the upper flap, consisting of the aponeurosis of the external oblique, the internal oblique and conjoined tendon to Poupart's ligament. Over this suture line, the lower flap of the aponeurosis of the external oblique was lapped, forming a new bed for the cord. Woolsey separated the fibers of the aponeurosis of the external oblique for a distance of $\frac{3}{4}$ of an inch to 1 inch (2 to 2.5 cm.) above the internal ring to avoid bulging at this point when the flaps are overlapped. The cord passes slightly upward and forward and then becomes superficial. A similar operation was described by Düringer. Earl advocated suturing the overlapped aponeurotic flaps beneath the cord.

Stetten closed the aponeurosis as follows: After the sac is ligated, excised, and the deep sutures placed, the upper flap of aponeurosis is sutured to Poupart's ligament. The lower flap of aponeurosis is incised perpendicular to its fibers, with double blunt-pointed scissors, at a point opposite the internal ring as far as Poupart's ligament. The smaller upper portion of the lower flap is carried across the cord and overlapped on the upper flap and sewed. The larger lower portion of the lower flap is passed beneath the

cord, lapped over the upper flap and sutured. The incised lower flap should fit as snugly as possible around the cord without constricting it. (Fig. 95.)

Scott, in 1905, described a modified Bassini-Halsted operation which is one of the best that has been devised and deserves to be more generally known: The sac is ligated and excised and the deep sutures placed as in the Bassini operation. The upper suture is placed snugly against the cord to narrow the internal ring as much as possible. If there is difficulty in bringing the conjoined tendon down to Poupart's ligament, a short relaxing incision is made through the fascia at the outer edge of the rectus. The old external ring is closed, the aponeurotic flaps united to a point halfway to the internal ring, the cord is laid on the lower half of the closed aponeurosis, and the upper half of the aponeurosis of the external oblique is sutured over the cord. To avoid constricting the cord, a nick should be made in the aponeurosis of the external oblique at the inner border of the new external ring. A stitch at this point will prevent the fibers from spreading.

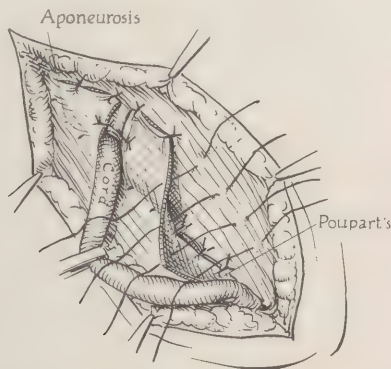


Fig. 95.—Inguinal hernia operation. Stetten's method brings the cord through a slit in the lower flap of aponeurosis, which is carried across the cord and overlapped on the upper flap.

I have found that it is unnecessary to nick the aponeurosis if a small director is placed beside the cord before the stitch at this point is tied; when the director is removed, there is plenty of room for the cord without danger of constriction. (Fig. 96.)

The advantages of this operation are the preservation of the obliquity of the canal and the complete closure of the external ring. Scott stated that in 543 operations by this method there were 5 recurrences.

Marro's Operation.—In the operation employed by Marro, the external ring is not divided, but a *parainguinal incision* is made through the aponeurosis of the external oblique $\frac{1}{2}$ inch (1.25 cm.) above the ring, nearly parallel with Poupart's ligament. The sac is freed and excised. With the cord lifted up, the deep sutures are started at the lower angle of the wound. Usually four interrupted sutures are required. The suture passes through the aponeurosis of the external oblique, the conjoined tendon or internal oblique muscle, and the shelving edge of Poupart's ligament. These sutures close the ex-

ternal ring securely. The cord is now dropped back and the internal oblique and Poupart's ligament sewed together over the cord.

Direct Inguinal Hernia.—The operation for direct inguinal hernia is not followed by the same high percentage of cures that is the rule in the oblique variety. Several factors are responsible for this state of affairs. They are: Neglect to recognize the direct hernia at operation; failure to realize that the ordinary operation for oblique hernia is insufficient in the direct type; a poor selection of cases, and the fact that the direct hernia is usually a recurrence, which makes the closure much more difficult.

A number of modifications of the oblique hernia operation have been devised for the cure of direct hernia, and when the hernia is small some surgeons do not transplant the cord. Important papers have been published by Schwartz, J., Wölfler, Halsted, Bloodgood, Coley, Downes, Schley, Hotch-



Fig. 96.—Inguinal hernia. Scott's method brings the cord through the overlapped aponeurotic flaps at a point half way down the line of incision. This gives an oblique inguinal canal, and permits the lower end of the wound to be closed firmly.

kiss, Huguet, Lusk, Hessert, and others. Skillern has emphasized the necessity of adapting the operation to the type of sac, as well as to the variety of hernia.

Direct Hernias That Usually Recur After Operation.—There are a certain percentage of direct hernias that can seldom be cured by operation: Large direct hernias in the obese or in subjects who have poorly developed abdominal muscles in both lower quadrants; hernias that bulge from the anterior superior spine to the edge of the rectus; and those that show on examination almost complete absence of the conjoined tendon and a separation of the aponeurosis of the external oblique.

Varieties of Direct Hernia.—There are two forms of direct hernia: The first variety pushes its way through the conjoined tendon and emerges at the external ring; the second variety bulges around the outer and lower edge of

the conjoined tendon and decreases in size as it extends outward toward the deep epigastric artery. This type of hernia is usually more favorable for operation than the first variety.

The Bladder in Direct Hernia.—The principal danger in operating on direct hernia is injury to the bladder, which is frequently adherent to the inner wall of the sac. Prevesical fat on the inner side of the sac should always be looked for, and the sac must be opened on its outer side as far as possible from the inner wall. With the sac held open, the bladder can often be seen as a fluctuating cystic tumor below and toward the median line. Traction on the sac wall causes the tumor to disappear, but it recurs as soon as tension is released. (For further information see the chapter on hernia of the bladder.)

Wilkie found the bladder present in 50 per cent of 42 direct hernias. I believe that it is practically always in the inner part of a direct hernial sac.

Injury to the Bladder.—The treatment of accidental injuries to the bladder is fully considered in the chapter on hernia of the bladder. If the bladder is in the sac, the latter should be carefully resected at a safe distance from the bladder, and the neck of the sac closed by a pursestring suture or, preferably, by a running suture such as is used for peritoneal suturing elsewhere, sewing from within outward so there will be no unnecessary pulling on the bladder.

Recurrent Inguinal Hernia.—Recurrent inguinal hernias are almost always of the direct variety, even when the original protrusion was oblique. The importance of making a wide dissection, and securing broad fascial flaps well beyond the scar tissue of the previous operation before attempting to deal with the sac, cannot be overemphasized. The vas deferens and spermatic vessels may be found anywhere in the scar tissue, their position depending on the technic of the former operation. They may be above the aponeurosis, between the layers of the aponeurosis, they may lie on the internal oblique, or they may be found below the internal oblique and transversalis.

OPERATIONS FOR DIRECT INGUINAL HERNIA

Wölfler's Operation.—Wölfler, in 1892, advocated incising the anterior rectus sheath, drawing the muscle down to Poupart's ligament and suturing it there. In 1898 Slajmer reported 150 operations by Wölfler's method.

Bloodgood's Operation.—In 1898 Bloodgood described an operation applicable either to oblique or direct hernia, in which a portion of the rectus muscle and its sheath are transplanted when the conjoined tendon is weak or obliterated, as is so often the case in recurrent hernias. The conjoined tendon is deficient when the finger passes beyond the external ring and encounters no obstruction in entering the abdominal cavity.

The anterior rectus sheath is incised for a distance of about two inches (5 cm.), and the rectus muscle and sheath drawn down and sutured with

the conjoined tendon and internal oblique to Poupart's ligament. If the sac is small it is isolated and reduced without being opened. In 1919 Bloodgood stated that recurrences are reduced if the cord is transplanted. (Fig. 97.)

Halsted, Hotchkiss, Lusk, and Berger secured a triangular flap from the anterior sheath of the rectus, turned it down, and sutured it to Poupart's ligament.

Blake's Operation.—In 1900 Blake devised the following operation: The internal oblique muscle is elevated and the posterior sheath of the rectus incised along its outer edge as far down as the pubic spine. The cord is lifted up and the rectus muscle sutured to Poupart's ligament. Next the internal oblique is sutured to Poupart's ligament, the cord is dropped back, and the edges of the aponeurosis overlapped.

Schley emphasized the importance of reenforcing the inner half of the inguinal canal in all cases where the conjoined tendon, which is principally

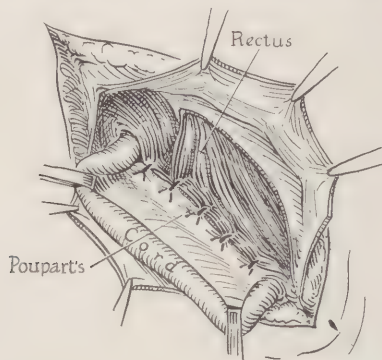


Fig. 97.—Inguinal hernia operation. (Bloodgood). Reenforcing the line of closure by opening the rectus sheath and bringing a portion of the rectus muscle down to the shelving edge of Poupart's ligament.

derived from the internal oblique, is weak, thin or deficient. This is best done by:

1. Opening the rectus sheath and drawing down the rectus muscle and suturing it to Poupart's ligament.
2. Suturing the inner half of the aponeurosis of the external oblique to Poupart's ligament over the deep sutures that unite the internal oblique and conjoined tendon to Poupart's ligament.
3. Transplanting the cord.
4. Overlapping the upper flap of aponeurosis of external oblique with the lower flap.

Downes' Operation.—In 1911 Downes described an operation for direct hernia in which the rectus muscle and fascia are used. I believe that this is probably the best operation for direct hernia and I use it whenever possible:

The sac is ligated and excised. The internal oblique and transversalis are lifted up at the internal ring by a blunt retractor, while the muscles are

dissected free, down to the point where they unite with the transversalis fascia at the outer margin of the rectus. Here the sheath of the rectus is opened and the muscle exposed down to the pubis. Three or four sutures of chromic catgut or kangaroo tendon unite the muscle to Poupart's ligament, the stitches being passed from below upward, one-half inch (1.25 cm.) apart.

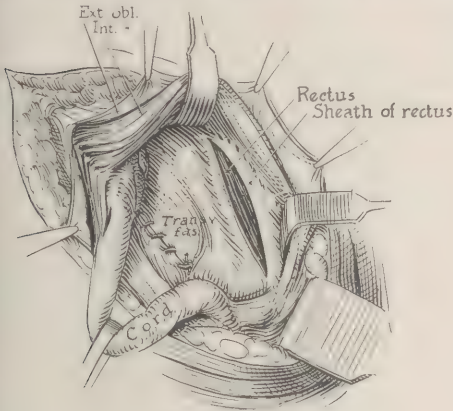


Fig. 98.

Fig. 98.—Downes' operation for direct inguinal hernia. The sac is ligated and excised and the transversalis fascia is closed as a separate layer. If an oblique hernia is also present the internal ring is sutured. The sheath of the rectus is opened, and the muscle exposed down to the pubis.

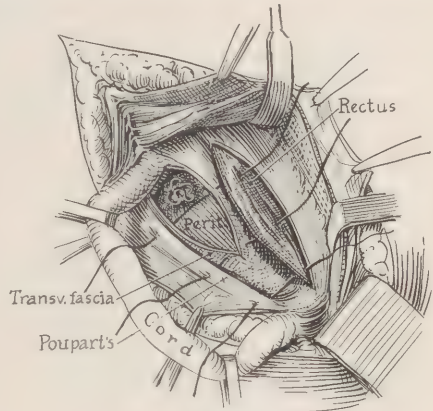


Fig. 99.

Fig. 99.—Rectus muscle exposed and sutured to Poupart's ligament.

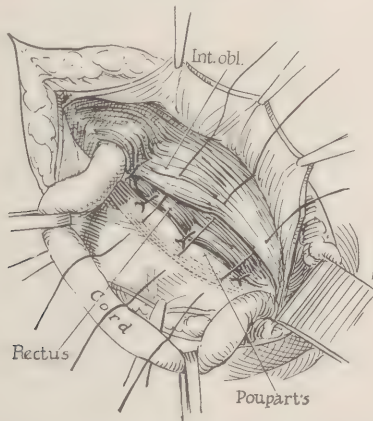


Fig. 100.—Downes' operation for direct inguinal hernia. Rectus muscle stitching completed. The internal oblique and conjoint tendon are sutured to Poupart's ligament (Bassini operation). Sometimes it is advisable to use the Andrews operation at this point.

The retractor is removed and the internal oblique sewed to Poupart's ligament under the cord by interrupted sutures. The edges of the aponeurosis of the external oblique are overlapped, giving three separate layers instead of two, as in the Bassini operation. (Figs. 98, 99, and 100.)

Davis' Operation.—In the operation described by Davis (G. G.), the sac is inverted, no attempt being made to dissect it out. The conjoint tendon is

divided transversely and the wound closed by overlapping the flaps from above downward.

Hoguet's Operation.—After exposing the hernia by the usual incision, the indirect sac, which is always present, is located, separated from the cord and opened. The deep epigastric vessels are not divided. By traction on the

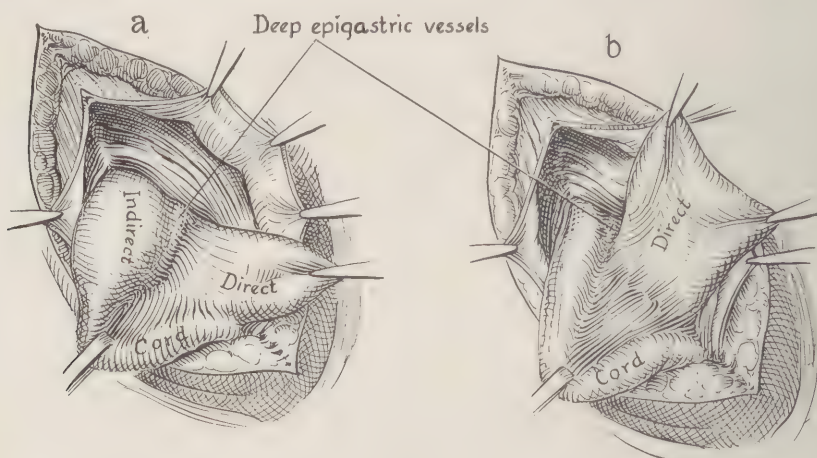


Fig. 101.—Combined direct and oblique inguinal hernia. (a) Direct and indirect hernial sacs exposed. (b) The indirect sac converted into a direct sac.

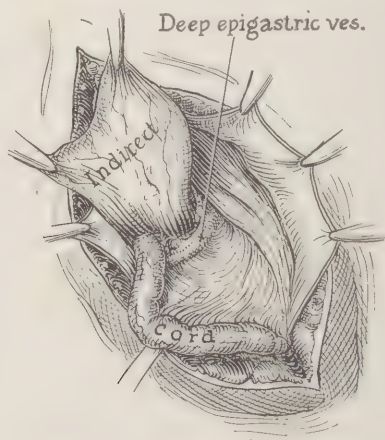


Fig. 102.—Combined direct and oblique inguinal hernia. The direct sac has been converted into the indirect variety. This is the safest way to deal with a direct sac on account of the proximity of the bladder.

oblique sac, the direct sac is drawn to the outer side of the deep epigastric vessels and the two sacs converted into one before opening. There is much less danger of wounding the bladder when this is done, than when the direct sac is opened internal to the epigastric vessels. (Figs. 101 and 102.)

After doing the Bassini operation and placing a stitch above the cord, the suture line is reenforced as follows: The inner edge of the aponeurosis

of the external oblique is retracted upward toward the midline, making a folded edge of fascia parallel to Poupart's ligament and about $\frac{1}{2}$ inch (1.25 cm.) above the lower border of the internal oblique. The sutures are passed through the reflected edge of the aponeurosis of the external oblique, the internal oblique and transversalis, and finally through Poupart's ligament below the cord. The wound should be well retracted when the deepest suture is placed. The upper flap of aponeurosis of the external oblique is brought down over the cord and stitched to the lower flap, overlapping the edges, if possible. The subcutaneous tissues and skin are closed.

In direct hernia, I place the first of the deep sutures just above the pubis, passing through the edge of the sheath of the rectus and the periosteum over the spine of the pubis.

Transverse Incision for Double Inguinal Hernia Operation.—In 1908 Edmunds described a downward curved incision for double herniotomy; and in 1913 Judd described a straight transverse incision extending from a point half way between the rings on one side, to a similar point on the opposite side.

Edmunds' incision is begun at a point midway between the two rings on one side, curves downward and passes across one inch (2.5 cm.) above the symphysis pubis within the pubic hair line, and curves upward on the opposite side, terminating at a point halfway between the two rings. This incision gives easy access to both hernias, and affords a good exposure in case transplants of rectus muscle or fascia are to be used. If the incision has been short, the scar will be hardly noticeable, usually it is almost entirely hidden by the pubic hair. For this reason it is frequently employed in operating on unmarried women.

Short Median Cosmetic Incision for Hernia Operation.—For small reducible hernias in females, Morestin made a vertical incision $1\frac{1}{4}$ to $1\frac{1}{2}$ inches (3.4 cm.) long in the midline in the mons veneris just above the os pubis and down to the aponeurosis. The wound is retracted to a point over the inguinal canal, the hernia exposed, and the operation carried out in the usual manner. When the wound has healed there is a very small scar, which is completely covered by the pubic hair.

Winter described a similar operation as follows: A 3 inch (7.5 cm.) median incision is made just above the pubes through the skin and superficial fascia. The incision is retracted to one side, the aponeurosis exposed over the inguinal canal, incised, and the usual Bassini operation done. The incision is then retracted to the opposite side and the second hernia repaired, finally closing the subcutaneous tissues and skin.

Anatomic Incision for Inguinal Hernia.—White (J. N.) described an incision that is made parallel to the blood and lymph vessels, and which is believed to hasten healing. The incision is made three-fourths of an inch (2 cm.) from the spine of the pubis, beginning at Poupart's ligament and at right angles to it, and extending toward the umbilicus for a distance of 3

inches (7.5 cm.). This is a good incision from an anatomic standpoint, but it does not give as free exposure of the inguinal canal as an oblique incision.

Short Oblique Incision for Inguinal Hernia Operation.—Many Italian surgeons use a very short oblique incision, made between the superficial circumflex iliac and the superficial epigastric vessels. No vessels are tied, and the inguinal canal is exposed by retracting the small opening in different directions.

Short Vertical Incision over the Internal Ring.—Mermingas advocated a short vertical incision directly over the internal ring, not opening the inguinal canal. He stated that it is indicated in small reducible hernias, and that the patient is out of bed sooner than after the ordinary operation. He also recommended it for the combined operation for appendicitis and hernia.

Low Lateral Rectus Incision.—Cheatle advocated a low lateral rectus incision for oblique inguinal hernia operations when there are no adhesions in the sac.

Transplantation of Fascia Lata in Hernia Operations.—Kirschner reenforced the hernia operation by securing a strip of fascia lata from the thigh. The strip of fascia should be longer than the area to be covered and 2 to 3 inches (5 to 7.5 cm.) wide. This "free" transplant is cut off and tacked over the line of suture of the aponeurosis of the external oblique. According to Kirschner, the advantages of fascia lata are: Its accessibility, abundance, strength, inelasticity, its readiness to heal in when transplanted, and it can be cut to fit an opening of any shape.

After considerable experimental study, Gallie and Le Mesurier found that the best results followed the use of fascia lata in the form of narrow strips six or seven inches (15 to 17.5 cm.) long and one-quarter inch (6 mm.) wide. These strips are threaded upon a curved, large eyed needle and woven into the edges of the surrounding muscles and aponeurosis, much as a sock is darned. No attempt is made to approximate the internal oblique or conjoined tendon to Poupart's ligament, but the gap is covered with the fascial strips instead. In 30 cases of inguinal hernia treated by this method there was no recurrence in two years.

Mann sutured the internal oblique, transversalis and conjoined tendon to the lower part of the shelving edge of Poupart's ligament. A fascial transplant $1\frac{1}{4}$ inches (3 cm.) wide is removed from the iliotibial band. The lower margin of the transplant is sutured to the upper part of the shelving edge of Poupart's ligament; the outer end of the transplant is placed close up against the internal ring, and the inner end reaches over the rectus sheath to a point near the midline of the body. The top border is sutured to the surface of the internal oblique and inward to the rectus sheath, thus strengthening both rings and the line of suture. Finally, the cord is placed between the flaps of aponeurosis and the subcutaneous tissues and the skin incision closed. Hume has used a similar operation with good results.

Pólya reported a patient who had had seven previous operations for inguinal hernia. The skin was a mass of scars and there were several fistulas. The skin and subcutaneous tissues over the hernia were excised and a flap, consisting of skin, fascia lata and sartorius muscle, was turned up from the thigh to close the defect.

Median Laparotomy Incision for Inguinal Hernia Operation.—Annan-dale, in 1876, operated on a strangulated inguinal hernia by median laparotomy. In 1883 Tait wrote that all hernias, except umbilical, should be operated on by abdominal section, the strangulated as well as the nonstrangulated varieties. His operations were done on women only. After reducing the hernia by cautious traction, the sac was incised if adhesions were present. The internal ring was not cut, but the opening was closed with interrupted sutures of horsehair.

Lucid, after completing the primary operation, placed the patient in the Trendelenburg position, and reduced the hernial sac and contents by taxis. To reduce the sac, it is sometimes necessary to grasp the bottom of it with a forceps and make traction. After ligating and excising the sac, the transversalis and internal oblique muscles are sutured to the posterior shelving edge of Poupart's ligament.

Abdominal Operations Through the Hernia Incision.—The removal of the appendix through the hernia incision is often permissible, but extensive abdominal or pelvic operations that necessitate enlarging the hernial opening, should not be attempted because of the difficulty in closing the hernial ring tight. The better plan is to complete the hernia operation, then make a midline or lateral rectus incision for the other operation.

The Removal of the Appendix Through the Hernia Incision.—It is often possible to remove the appendix through the hernia incision. DeTarnowsky, La Roque, Schrager, Cohen and others advocated it as a routine procedure.

I believe no attempt should be made to remove the appendix unless there is a history of attacks of appendicitis, or the appendix is large and readily palpated through the right internal ring, and the cecum freely movable and easily drawn down into the wound.

Occasionally the appendix is in the hernial sac and it may be inflamed, gangrenous, or the site of an abscess. When an infected appendix is removed through a hernia incision I always make a stab-drain in the appendix region.

One of the best combined operations for appendicitis and hernia was described by Torek, as follows: The usual skin incision for hernia is extended as far as the anterior superior spine of the ilium, and the aponeurosis is split from the external ring outward and upward, separating at the upper end the fibers of the external oblique muscle for a distance of 1 to 1½ inches (2.5 to 4 cm.). The flaps are retracted, the internal oblique and transversalis muscles split in the direction of their fibers, the peritoneum exposed and opened, and the appendix removed and the wound closed. The hernia opera-

tion is carried out according to the technic already described. Voelcker described a similar operation.

Autoplastic Operations for Inguinal Hernia.—The repair of hernias by the use of fascia transplants is one of the most valuable measures in large hernias. The use of bone and periosteal flaps has been generally abandoned.

Trendelenburg employed plates of decalcified bone, and also turned up a flap of bone and periosteum from the pubes. Kraske used a similar method.

Thiriar advocated the use of decalcified bone plates $1\frac{1}{4}$ to 2 inches (3 to 5 cm.) in length and $\frac{1}{3}$ to $\frac{1}{2}$ inch (8 to 12 mm.) thick. The plate used was a little larger than the hernial opening, and it was placed next to the peritoneum and held in position by the sutures which close the opening, passing over it.

Schwartz (E.) recommended closing the hernial opening by a muscle flap in the following manner: After freeing and ligating the hernial sac, the sheath of the rectus is opened and a pedicle of muscle, which is left attached below, is secured. This flap, which is about 2 inches (5 cm.) long, is passed through an incision in the lowest part of the rectus sheath at its outer border. The muscle flap is sutured first to the internal oblique and conjoint tendon and then to Poupart's ligament. The opening in the rectus sheath is sutured and the edges of the aponeurosis united.

Another myoplastic method was described by Mantelli as follows: An incision is made over the inguinal canal and extended down over the sartorius muscle, which is divided at its upper third, leaving its posterior fascial sheath intact. The muscle flap is turned up over the inguinal canal, sutured to Poupart's ligament on the outside and to the rectus muscle on the inner side. Mantelli stated that he had secured good results with this method in recurrent hernias. Streissler also described a myoplastic operation in which the sartorius was utilized to close the inguinal canal.

Pouillet secured a fibroperiosteal flap from the adductor longus at its insertion into the pubis. The flap is turned up along with the periosteum to which it is attached, for a distance of 1 inch (2.5 cm.), and is placed behind the cord and sutured to the pillars of the external ring. Lenormant secured a periosteal graft from the anterior internal surface of the tibia.

Heteroplastic Operations for Inguinal Hernia.—Silver filigree has been used by many operators, notably Phelps, Meyer, McGavin, and Bartlett. However, silver filigree and other heteroplastic operations are seldom used at the present day, because any opening that can be closed by a wire can also be closed by a fascial transplant with a much better chance of cure.

Fiore preferred gold to silver wire, as the former can be drawn much finer, is more flexible and less irritating. Scandola closed the internal ring with a sponge. Nicoll drilled two holes $\frac{3}{4}$ of an inch (2 cm.) in the horizontal ramus of the pubis, and brought down and fastened the internal oblique and conjoint tendon with mattress sutures of catgut or kangaroo

tendon, passed through these holes in the bone. Nélaton and Ombrédanne brought the cord through a groove in the os pubis.

Darn and Stay-Lace Method.—Bennett (C.) and Handley described the following method for large hernias and believed it superior to the use of wire filigree:

Instead of the usual deep sutures, a slack stay-lace stitch of silk is taken first from above downward, and returning it is made to emerge at points between the stitches previously inserted. This stay-lace is tied lax. The aponeurosis of the external oblique from Poupart's ligament to a point two inches (5 cm.) above the cord is darned with silk, exactly as if it were a weak spot in a stocking. The successive stitches should lie straight and without tension, and finally the skin and subcutaneous tissues are closed. This method is open to the same objection that applies to all nonabsorbable sutures—namely, the danger of suppuration—and it is not to be recommended on this account.

Nota reported 150 inguinal hernia operations in children in which he inserted a crescent-shaped sheet of paraffin beneath the cord, with the horns extending upward under the pillars of the ring on each side. The inguinal canal was closed with three layers of sutures. This operation is not to be recommended as it has the same disadvantages as the paraffin injection treatment—the foreign body acts as an irritant which favors infection and recurrence.

OPERATIONS FOR HERNIA AND UNDESCENDED TESTIS

The testis may be found in any of the following locations: In the abdomen, at the internal ring, in the inguinal canal, below the external ring, in the perineum, in the femoral region, or it may be interparietal (in the abdominal wall).

When the testis is as high as the internal ring, it is usually advisable to place it in the abdominal cavity; when it is in the inguinal canal or beyond the external ring, it can almost always be brought down into the scrotum.

In early times the surgeons removed the testis. Kraske thought it was too difficult to dissect out the sac unless the testis was removed; Thiriar excised it as a precaution against malignant degeneration.

The testis is no longer sacrificed. Its importance to the future development of the patient from an endocrine standpoint is recognized, and an effort is always made to preserve it and to place it in the scrotum, if possible; if this cannot be done, it should be replaced in the abdominal cavity.

Pannett stated that when the testis is replaced in the abdominal cavity its secretory function is not interfered with, but there will be no spermatogenesis, as the seminal tubules are unable to secrete on account of the high intraabdominal pressure.

Operative treatment is seldom indicated in children under four years

of age. The best treatment for these little patients is massage and traction on the cord and testis to favor descent.

A truss should not be fitted to a hernia associated with undescended testis, unless it can be done without making the least pressure on the testis. If it is impossible to separate the testis and the hernia, operative treatment is usually advisable.

The most favorable age for operation for undescended testis is between the sixth and twelfth years. In very young children the testis and cord structures are so small and delicate that it is difficult to handle them without injury. If the operation is delayed beyond the twelfth year, the development of the testis is retarded and it is more difficult to bring it into the scrotum.

Many operations have been devised to hold the testis in the scrotum: Monod and Richelot sutured the cord to the pillars of the external ring; Cheyne and Tuffier caused traction to be made on the testis from a distance. Bérard sutured the cord to the tunica vaginalis testis; and Ombrédanne carried the testis to the opposite side of the scrotum and fixed it there with a suture.

Bevan's Operation.—The best operation for undescended or maldescended testis is the one devised by Bevan in 1899: The incision through the skin, subcutaneous tissues and aponeurosis of the external oblique is made just as for a hernia operation. The cremaster muscle and transversalis fascia are incised, and the sac separated from the cord. The sac is very thin and easily torn, especially in children. It is divided and the upper portion ligated and excised; the lower portion is treated the same as in congenital hernia, in which the sac communicates with the tunica vaginalis. The portion of sac lying in contact with the testis is sutured over it.

The testis is lifted up out of its bed, the cord lengthened as much as possible by gentle traction, and at the same time, the fascial bands, which are seen in the cord are loosened; all the surrounding fascia is stripped from the cord, leaving only the vessels and the vas deferens, which lie behind the posterior layer of the peritoneum, and they are separated from it by blunt dissection.

The vessels pass upward and inward and the vas deferens passes downward and inward from the external ring. After carefully freeing the vessels and vas deferens, it is usually possible to bring the testis down into the scrotum, three to four inches (7.5 to 10 cm.) below the external ring. (Fig. 103.) If the testis does not come down, it may be necessary to divide the spermatic artery and veins between ligatures to secure sufficient lengthening of the cord. Bevan has found that this was necessary in only about 10 per cent of his cases.

Next, a pocket is formed in the scrotum by blunt dissection (Fig. 104), the testis placed in it and the upper part of the pocket closed by a purse-

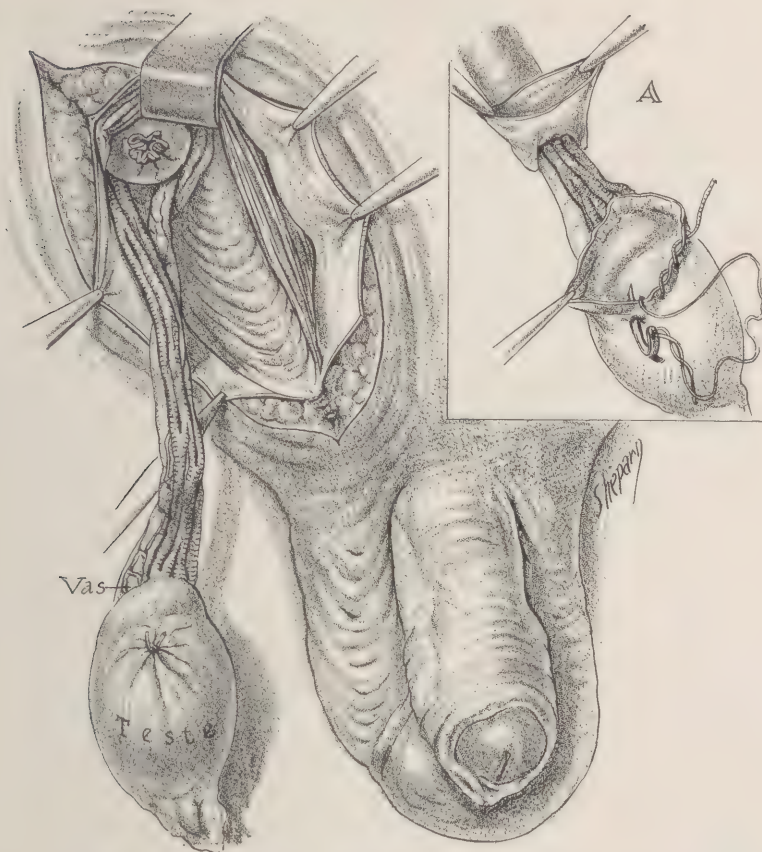


Fig. 103.—Bevan's operation for undescended testicle. The cord is lifted out of its bed and the fascial bands, which are seen in the cord are loosened; all the surrounding fascia is stripped from the cord, leaving only the vessels and vas deferens. It is seldom necessary to divide the spermatic artery and veins. (A) Suture of the tunica vaginalis testis over the testicle.

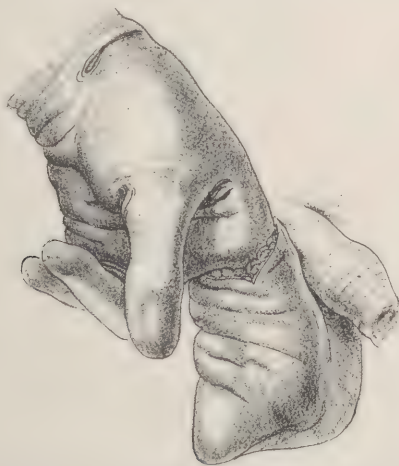


Fig. 104.—Bevan's operation for undescended testicle. A pocket for the testicle is formed in the scrotum by blunt dissection.

string suture, which is passed through the dartos and placed in such a way as to avoid making pressure on the cord. This suture prevents the testis from entering the inguinal canal or being dislocated above the ring on to the aponeurosis. (Fig. 105.) The wound is closed without transplanting the cord or suturing the testis in the scrotum.

Results Following the Bevan Operation.—Coley and Hoguet reported 441 cases in which the Bevan operation was employed with the following

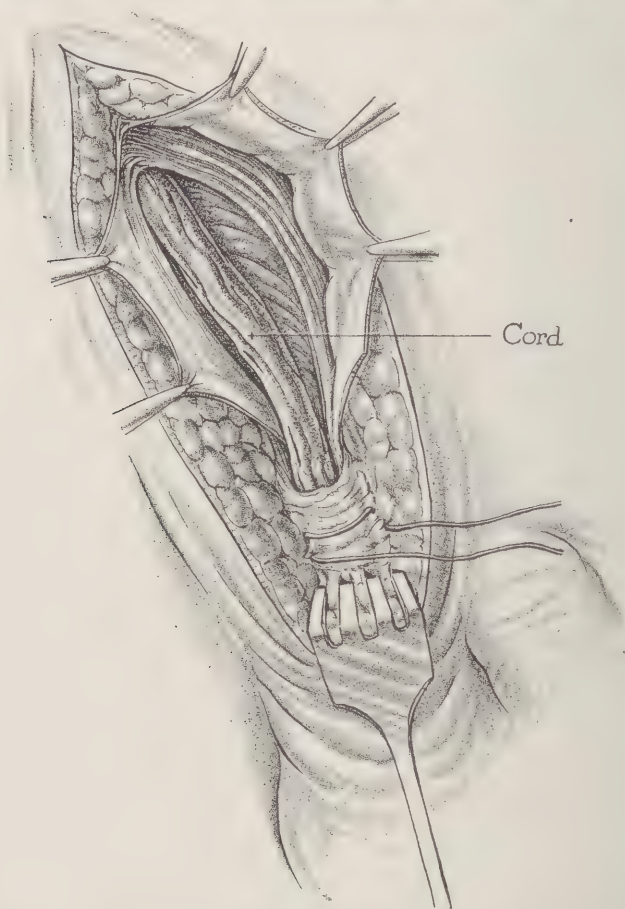


Fig. 105.—Bevan's operation for undescended testicle. The testicle is placed in the newly-formed pocket in the scrotum and a pursestring suture placed in the dartos in such a way as to avoid making pressure on the cord. This stitch prevents the testicle from entering the inguinal canal or being displaced above the ring on the aponeurosis.

results: There was not a single case of gangrene of the testis; in the majority of cases the testis remained in the lower or middle part of the scrotum and in a number of cases it was near the external ring; when the testis was normal at the time of operation, it continued to develop; atrophied testes did not grow after operation.

A few cases of gangrene of the testis following the operation, in which

it was necessary to divide the spermatic artery, have been reported in the literature. I believe these bad results may be avoided if the tissues are handled very gently throughout the operation.

Calverley pointed out that before operating on patients with small testes, their attention should be called to the condition. If the small testis was accidentally discovered later by the patient, he would blame it on the operation.

Results Following Operation for Undescended Testis and Hernia.—The results following operation for undescended testis and hernia are much better in children than in youths or adults. Coley stated that no recurrence of hernia had been observed in 314 operations for undescended testis and hernia.

Ombredanne's Operation.—Ombredanne used the following operation: A finger is passed from the wound in the scrotum through the septum into the opposite side of the scrotum, where the skin is incised, and a forceps passed through to grasp the ends of the suture that closed the tunica vaginalis over the testis. The suture is tightened, thus pulling the testis through the septum to the opposite side of the scrotum where it is sutured.

Interparietal Hernias.—There are three varieties of interparietal hernias: Properitoneal, interstitial, and inguinoperitoneal.

1. *Properitoneal Hernias.*—Properitoneal hernia usually has a bilocular sac, one loculus in the inguinal canal and the second one between the peritoneum and the transversalis, or between the internal oblique and the aponeurosis of the external oblique. The operation is the same as for inguinal hernia. Both sacs should be removed. They are often associated with undescended testis.

2. *Interstitial Hernias.*—Interstitial hernia is usually found between the aponeurosis of the external oblique and the internal oblique, and is easier to recognize than the properitoneal variety, as it is more superficial and usually has only one sac. This hernia is almost always associated with undescended testis.

The treatment consists in removing the interstitial sac, closing the hernial opening and dealing with the undescended testis. If there are symptoms of obstruction or strangulation in interstitial or properitoneal hernia, and the external sac in the upper part of the scrotum is empty or contains reducible intestine or omentum, the index finger should explore the neck of the sac and search for the interparietal sac and its constricting band, which should be divided only when it is plainly exposed to view. Sometimes the contents of both the external and internal sacs are irreducible, and in this case it is necessary to open both sacs, sever the constrictions, and reduce the contents after dealing with them as their condition demands.

3. *Inguinosuperficial Hernias.*—Inguinosuperficial hernia is found lying on top of the aponeurosis covered only by skin and subcutaneous tissues. The diagnosis is not difficult if the examiner is on the lookout for the condition, as the testis in its subcutaneous position bulges outward when the patient

coughs. It is almost invariably associated with undescended or maldescended testis, and is most frequently found in children.

The treatment is the same as for hernia associated with undescended testis. In making the skin incision, care must be taken not to injure the testis or cord, which are very superficial.

Inguino-Perineal Hernia.—Inguino-perineal hernia is due to maldescent of the testis into the perineum. The sac is freed and treated the same as in congenital hernia. A new tunica vaginalis is formed from the lower portion of the sac. If the cord is short it is not transplanted, and the testis is placed in a new bed in the scrotum as described in Bevan's operation.

New Growths in the Undescended Testicle.—New growths in undescended testicles are rare. Cunningham collected from the literature 452 cases of tumors of the testes; in 40 of these, the testis was imperfectly descended. Lipshutz has made a careful study of the pathology of tumors of the undescended testicle.

PREOPERATIVE TREATMENT

1. Simple or Uncomplicated Cases.—The average patient with nonstrangulated inguinal hernia comes to operation in good condition and requires little preliminary treatment. However, he should spend the night preceding operation at the hospital to become accustomed to his bed, and to receive whatever preparatory treatment is necessary.

A mild cathartic is usually administered the night before and a low enema given the morning of the operation. Drastic purging and repeated enemas are not only unnecessary, but actually harmful as they diminish the "tone" of the intestines and predispose to postoperative intestinal paresis and gas pains. It is very important for the bladder to be emptied just before the operation.

The field of operation should be shaved and an antiseptic dressing applied and left on until the patient reaches the operating room, when it is removed and the field painted with tincture of iodine (3 per cent) or picro acid solution (5 per cent).

While many operators dispense with the preliminary dressing and simply paint the field of operation with benzoin and tincture of iodine followed by alcohol, at the time of operation, I believe that this method sometimes fails in that the antiseptics do not reach the germs lying in the deeper layers of the skin and in the hair follicles.

Antiseptics for the Skin.—The most generally used disinfectant for the skin is tincture of iodine. It should never be used stronger than a 3 per cent solution, as the skin is very easily blistered by this antiseptic. Some patients have a decided idiosyncrasy for iodine. There are other antiseptic solutions that equal it in germicidal power and do not blister and irritate the skin. The most popular of these is picro acid 5 per cent and alcohol 95 per cent.

Another good antiseptic, which also contains a fat solvent, is McDonald's solution, consisting of acetone 40 parts, alcohol 60 parts, to which is added pyxol 2 parts.

Needles.—I use a full curved, round-pointed, needle for all of the sewing except for the skin. Some operators use a full curved cutting-point Hagedorn needle for all the suturing. De Garmo used a round full curved cervix needle three-quarters of an inch (2 cm.) long, with the point filed off. (For additional information on preoperative treatment, see the chapter on general considerations.)

2. Complicated Cases.—The dangers of operating on large irreducible hernias in obese patients, and the complications that may occur in patients with cardiovascular, renal or pulmonary disease, are taken up in the section on prognosis.

The preliminary treatment of irreducible scrotal hernias that have lost their *right of domicile* in the abdominal cavity is the same as for irreducible umbilical hernias, and is described in the chapter on umbilical hernia. The object of this preliminary treatment, which requires two to six weeks' time or longer, is to reduce the intraabdominal fat so that the hernia can be reduced with as little increase as possible in intraabdominal tension, thereby lessening the danger of cardiovascular and pulmonary complications.

Patients suffering from advanced pulmonary disease should never be operated on for hernia except in case of strangulation. Bronchitis or a cough of any kind should be cured before operation, as the recumbent post-operative position favors the development of hypostatic congestion of the lungs or pneumonia, and the persistent coughing favors the recurrence of the hernia.

Before operating on large or only partially reducible hernias, the intestines must be thoroughly emptied to decrease intraabdominal tension as much as possible.

Sliding Hernia.—When it is difficult to locate and free the sac, especially in large hernias, sliding hernia of the large intestine or bladder is always to be thought of. Sliding hernia on the right side, usually involves the cecum and appendix; and on the left side it involves the sigmoid. A portion of the bladder may be included on either side, and rarely it may be the sole content of the hernia.

To treat sliding hernia, it is necessary to extend the ordinary incision for inguinal hernia upward and to open the abdomen. The sac is opened at a point where the contents can be seen to slide, or where the sac can be lifted up from the contents. If the intestine is adherent to the sac, the latter should be incised midway between the two loops of intestine. The edges of the sac are brought together behind the loop of intestine and united with a continuous suture, thus providing a peritoneal covering for the extrasaccu-

lar intestine, which is returned to the abdominal cavity. The hernial opening is closed in the usual manner. (For further details see the chapter on hernia of the large intestine.)

ACCIDENTS DURING HERNIA OPERATIONS

1. Injury to the Intestine.—The intestine is sometimes incised by mistake for the sac, especially in sliding hernias. Occasionally intestine is in the sac and is not recognized, or is mistaken for omentum.

An accidental incision of the intestine should be repaired immediately by Lembert sutures, or if the opening is very small, a pursestring suture will be sufficient. A second running stitch is used to reenforce the first row; and finally, a piece of omentum should be tacked over the wound to prevent leakage and adhesions.

A loop or knuckle of intestine may be caught in the ligation of the sac. This accident can always be avoided if the sac is opened, even though it is very small, and carefully examined before ligating; its interior should also be inspected after ligating, before cutting off the sac. To prevent omentum and intestine slipping into the open sac, Miller suggested applying an Allis forceps to the peritoneum above the point of ligation, and closing the blades to hold back the omentum and intestine while the ligature is being tied.

2. Injury to the Bladder.—The bladder is liable to be wounded in any operation for hernia. In direct hernia the inner wall of the sac is often in contact with the bladder, which may be injured unless great care is taken in freeing and ligating the sac. If the bladder wound is recognized and carefully closed, there is little danger. The serious cases are those in which a portion of the bladder is excised by mistake for the sac, or when the viscus is penetrated by the needle during the closure of the wound, and the accident not recognized until several hours later when the symptoms of peritonitis appear. (For further details see the chapter on hernia of the bladder.)

A persistent urinary fistula may follow injury to the bladder, necessitating a subsequent operation to close it. If a suspicious looking "cyst" is encountered during operation, the possibility of it being bladder can be excluded by one of the following methods: Injecting methylene blue solution into the bladder; distending it with air or water; passing a sound into it and palpating the tip in the wound; and by aspirating the "cyst" with a fine hypodermic needle and testing the fluid for urine.

Position of the Bladder in Infants and Children.—In infants and young children the bladder is situated higher than in older children. This point must be borne in mind, so as not to mistake the bladder for the hernial sac.

3. Injury to the Vas Deferens.—The vas deferens can be recognized by its hard cord-like feel. It is often intimately adherent to the sac in complete congenital hernia and dissection may be difficult. Care must be taken not to incise or divide it. If it is accidentally divided, it should be repaired by

passing a fine plain catgut suture into the lumen of each cut end and then out through the wall; tying a knot in each end of the suture approximates the divided ends. (Fig. 106.) A better method is to cut off the ends obliquely and do an end-to-end suture by using a very fine No. 16 cambric needle threaded with silk, such as is used in blood vessel repair.

4. **Injury to the Spermatic Artery.**—The spermatic artery can be located by feeling its pulsation in the cord. It should never be unnecessarily divided, as cases are on record where atrophy or necrosis of the testis has followed the severing of this artery. Griffiths, Bevan, and others have shown that the artery of the vas deferens is usually sufficient to prevent atrophy or gangrene of the testis.

5. **Faulty Ligation of Sac.**—The sac should never be ligated without first transfixing its neck in order to prevent the ligature from slipping. Faulty ligation may be followed by a slipping of the ligature before the deep sutures are placed, and the escape of intestine and omentum through the

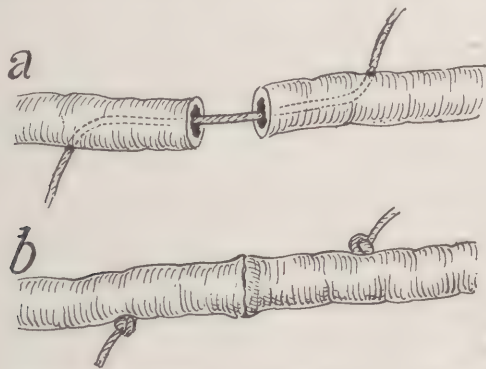


Fig. 106.—Method of repairing the divided vas deferens by passing a plain catgut thread through the lumen of each end, and tying a knot in each end of the thread.

opening; if the ligature slips after the deep sutures are inserted, it leaves a depression at the internal ring which predisposes to a recurrence.

6. **Injury to External Iliac Vessels.**—While injury to the external iliac artery or vein is rare, the possibility of it should always be remembered when passing the deep sutures through the shelving edge of Poupart's ligament. To avoid this accident, the shelving edge of Poupart's ligament should be well exposed, and care exercised not to take too deep a bite in it.

In operating for recurrent hernia, especial care must be taken to avoid the external iliac vessels, which are sometimes very superficial on account of the thinning out of Poupart's ligament. The needle should be guided through the shelving edge of Poupart's ligament by the tip of the index finger, or the finger can be placed to the outer side of Poupart's ligament and the iliac vessels depressed as the needle is passed through the shelving edge. It is a serious accident to injure the vessels. When it happens, it is necessary to expose the vessel and suture the rent, using a No. 16 cambric

needle threaded with human hair or the finest silk suture, coated with vaseline. Every surgeon should have these needles and sutures in his instrument bag at all times.

In 1,000 operations for inguinal hernia, O'Connor wounded the external iliac vein in two patients while putting in the deep sutures. In both instances he was using a sharp curved needle. In one case amputation of the foot was required; in the other the wound in the vessel was sutured without any after-effects.

7. Injury to the Deep Epigastric Vessels.—The deep epigastric vessels are easily tied if wounded, unless the injury is inaccessible and located near the origin of the deep epigastric artery from the external iliac artery, when it is necessary to treat it the same as an injury of the external iliac artery, which has just been described. Erdmann reported a case in which he accidentally severed the deep epigastric artery at the point where it leaves the external iliac artery. To control the hemorrhage he was compelled to suture the rent in the external iliac artery. He believed the accident was due to the use of a cutting-edge needle.

Allen said that while operating on the second side of a double hernia he noticed blood in the abdominal cavity. He reopened the first wound, and found a small bleeding vessel in the peritoneum just above the neck of the sac.

POSTOPERATIVE COMPLICATIONS

The postoperative complications following a hernia operation are similar to those following other abdominal operations. Under local anesthesia they are reduced to a minimum, and with gas oxygen they are less severe than with ether.

1. Tympanites.—Gas pains are common and are undoubtedly the most painful of all complications. The best preventive measures are: Careful preoperative treatment; a well-padded operating table; encouraging the patient to move about and turn from side to side as soon as he is returned to his bed; the use of carminatives by the mouth; small doses of pituitrin, 5 to 10 m hypodermically every 3 to 4 hours, for simple nonstrangulated hernia patients; low enemas; the frequent introduction of the colon tube with the first symptoms of discomfort; and the use of the duodenal tube in severe toxemia. The routine use of cathartics should be avoided, because as pointed out by Long, they increase meteorism and the danger of ileus.

Abdominal Massage.—I have found that abdominal massage is by far the most effective treatment for gas pains. I instruct the nurse to massage gently the upper half of the abdomen ten to fifteen minutes out of every hour during the first 24 hours, or until the bowels move well. I give a mild laxative the night following operation to patients who have been operated on under local anesthesia. When general anesthesia is employed, the laxative must sometimes be deferred until the second day on account of the nausea.

2. **Retention of Urine.**—Measures that will help the patient to void urine voluntarily are: The sound of water running; a hot water bottle over the pubis; hot or cold compresses to the perineum; a change in position; and a warm enema. Catheterization should be done only as a last resort on account of the danger of cystitis. The average patient can go eight to eighteen hours without catheterization.

The exception to this rule is in cases of injury to the bladder, when the patient should urinate or be catheterized without delay every four hours. These patients should receive argyrol instillations after each urination or catheterization to prevent cystitis and to keep them unaware of the bladder injury. Methylene blue can be administered by mouth, enough to discolor the urine, if the instillations of argyrol cannot be used.

As a rule, a patient should be allowed to sit on a commode or stand up to urinate before resorting to catheterization. I have seen cystitis in the aged, caused by catheterization, persist for years after the operation.

3. **Secondary Hemorrhage.**—The slipping of a ligature on a blood vessel may sometimes be followed by a hemorrhage that saturates the dressings and necessitates the opening of the wound, and the ligation of the bleeding vessel. A hematoma, due to oozing from veins in the cord, may involve the operative wound, the scrotum, and extend part way down the thigh. If not treated, it may require two or three months' time for it to be absorbed. The best plan is to make a small incision over the mass, evacuate the clot, and apply firm pressure over the area to prevent any further bleeding. Unopened hematomas are often the cause of postoperative hydroceles.

4. **Traumatism of the Cord.**—Traumatism or rough handling of the cord is sometimes followed by thrombosis, which is the usual cause of orchitis and epididymitis when they follow hernia operations. If the veins in the cord are excised during a hernia operation, postoperative hydrocele will frequently develop. The veins should be left undisturbed. Swelling of the epididymis and testis can be minimized by applying a firm muslin bandage to the scrotum immediately following operation.

5. **Thrombosis and Embolism.**—Thrombosis usually develops in the veins of the cord or in the veins of the omentum, as a result of traumatism or the ligation and excision of omentum. Rarely it may appear in the veins of the mesentery or in the veins of the abdominal wall. If it is localized, pain and swelling in the affected parts result.

Meyer stated that the best preventive of embolism is to keep the patient in a slight Trendelenburg posture while he is in bed. If embolism occurs, it is usually in the lungs, and an infarct of the lung is almost always fatal. I have seen embolism appear on the sixth day after an operation for hernia in a man, 50 years old. Death took place about five minutes after the first pulmonary symptoms were noticed.

McGavin saw a man, aged 38, who developed a thrombosis of the left

internal saphenous vein on the tenth day after operation. Gradual recovery followed with treatment by rest, elevation of the limb, and the application of heat.

Phlebitis of the femoral vein, with edema and swelling of the extremity of the affected side, sometimes follows an operation for inguinal hernia. In these cases there is always danger of pulmonary embolism.

Fagge observed an unusual case of retroperitoneal hematoma following a hernia and varicocele operation in a man. The tumor had been mistaken for a number of conditions, most often for hypernephroma. Fagge operated four months after the first operation and found that the hematoma was due to a slipped ligature from the varicocele operation.

Ribas y Ribas reported a case of intestinal obstruction occurring two days after a hernia operation. The site of the hernia operation was normal.

Bloodgood reported a case of postoperative intestinal obstruction, due to the forcing of a loop of intestine into Treitz's fossa from the retching following general anesthesia.

Lee reported a case of gastrointestinal hemorrhage in a man, occurring fifty hours after an operation for double nonstrangulated hernia.

Mitchell reported a chancre, which developed in a stitch abscess following a hernia operation.

Suppression of urine is sometimes a complication of general anesthesia. It may terminate rarely in a fatal hematuria. I was once called in consultation to see a young man, 25 years old, who had always had excellent health prior to an operation for simple bubonocoele. I was informed that the operation with ether anesthesia had lasted an hour. Anuria was complete for twelve hours following the operation, when a few ounces of bloody urine were obtained by catheterization. The urine gradually diminished in amount and the patient died on the third day.

Other Complications.—Complications, such as shock, fever, bronchitis, pneumonia, erysipelas, tetanus, and infection of the wound, etc., that are common to all abdominal operations, will not be considered here. Complications encountered in tropical countries are: Elephantiasis, chylocele and filarial lymphangiectasis.

POSTOPERATIVE TREATMENT

1. **The Dressings.**—After operation a light gauze dressing should be applied and held in place by adhesive tape or bandage. Frank (L.) believed that the pressure of a large pad sometimes is the cause of delayed healing. (For dressings in infants and children see the next chapter.)

2. **Position of the Patient in Bed.**—The patient should be kept in a jack-knife position by elevating the shoulders on two pillows and by resting the knee of the affected side on a pair of pillows. In this position the

muscles and aponeurosis are relaxed, and there is less strain on the deep sutures than when the thigh is straight.

The Gatch bed is excellent for hernia patients. It permits elevating the trunk and thighs, and the patient can be made more comfortable than in the ordinary bed.

3. **Postoperative Rest.**—The patient is kept in bed ten days to three weeks, depending on the variety of the hernia and the size of the opening. Aged patients are gotten out of bed as soon as possible, and all patients should be cautioned not to do any work for three months after the operation, and only light work for the following six months. They should be warned against a gain in weight, which increases intraabdominal tension and puts added strain on the wound, thus favoring recurrence. A change of work, which brings new groups of muscles into use thus lessening the chance of recurrence, should be advised.

4. **Postoperative Pain.**—As a rule, the patient should be kept comfortable after an operation for nonstrangulated hernia by small doses of codein or morphin for the first 24 hours. Opiates are contraindicated in children, in the aged, and after operations for strangulated hernia.

5. **The Diet.**—After operations for simple reducible hernia, liquid diet is best for 24 to 48 hours, then soft diet.

6. **The Support of the Scrotum.**—The dressings are held in place by adhesive straps and a wide piece of gauze is placed under the scrotum. A snugly fitting spica bandage of unbleached muslin or canton flannel is applied so as to hold the gauze supporting the scrotum, and is fastened by safety pins. This bandage should be put on so that it holds the scrotum snugly up against the pubes. It not only gives the patient support, permitting him to turn about in bed, but also reduces the danger of secondary hemorrhage, orchitis and epididymitis.

In adults an elastic bandage applied in St. Andrews' cross fashion will help to hold the dressings securely, and to keep the thigh from being moved too freely. Some patients are more comfortable if a suspensory is worn while in bed to support the testes.

INSTRUCTIONS FOR INGUINAL HERNIA PATIENTS AFTER OPERATION

The site of your hernia operation will be weak for a few months. Your improvement should be progressive, and you can do much to get well and stay well by observing the following instructions:

The hernia wound will be sensitive for several months. You should not let anything rough or irritating press on it. You should not wear a truss, tight belt or corset. You can wear an elastic abdominal support for a few months, especially if you are overweight or have a pendulous abdomen. Be careful that it is loose above, and fits snugly only over the wound. You must not gain in weight for at least a year, as that increases the danger of the hernia recurring.

You can take light exercise, such as short walks and riding on smooth roads. Jolting, strains, lifting, swimming, horseback riding and sports or work that require strenuous exer-

tion must be avoided for at least three months. After that time you can do light work; heavy manual labor should be avoided for at least six months. It may be advisable to change your occupation so that new groups of muscles will be brought into use.

You will gain strength most rapidly if you get plenty of sleep, avoid all kinds of mental excitement, and get an abundance of fresh air and eat simple wholesome food. Live principally on milk, buttermilk, butter, cereals, fresh vegetables and fruits.

Avoid constipation by natural means, as far as possible: Drink plenty of water, eat coarse vegetables and fruits, and whole wheat or bran bread. Establish a regular hour for going to stool. Sometimes a mild laxative is necessary—salts and strong cathartics should be avoided. Yeast, cascara, and phenolax are the best laxatives for you.

If in doubt about anything, consult your physician, who has been informed fully regarding your operation, and knows the treatment you should follow. Please report your condition by mail every 3 months for the next two years.

(These printed instructions are given to patients when they go home.)

RECURRENCE

The most frequent causes of recurrence are:

1. **Failure to Remove All of the Sac.**—A portion of the sac may be left through careless or incomplete dissection, or a dimple or funnel-shaped process may be left in the peritoneum when the sac is not ligated high enough. Sometimes there is an hour-glass constriction of the sac, and the lower portion of the constriction is mistaken for the true neck of the sac, which is actually located one to two inches (2.5 to 5 cm.) higher up.

2. **Faulty Methods of Closure.**—Faulty closure of the hernial opening may be due to several causes: Failure to make a correct diagnosis; an attempt to make a standardized technic fit all cases; neglect to make the cord as small as possible by dissecting off everything but the vas and blood vessels; failure to close the internal ring tightly around the cord; failure to unite firmly the internal oblique and conjoint tendon to Poupart's ligament; and failure of the primary operation to repair wholly the original defect.

Inguinal Lipomata.—Fatty masses attached to the sac or cord should be ligated as high as possible and removed. They are most often found in obese subjects, and unless they are removed the inguinal canal cannot be closed tightly.

3. **Double, Saddle-bag or Pantaloon Sacs.**—Double sacs are the cause of recurrence more often than is generally supposed. These sacs may be left for one of the following reasons: In direct hernia the operator may overlook the oblique sac, which is nearly always present and should be removed; in oblique hernia he may overlook a direct sac, which is sometimes present. Both oblique and direct hernias may have bilocular sacs, and unless both of these loculi are found and removed, the hernia will remain uncured.

The surest way to locate these double sacs is to do the operation under local anesthesia, because, after the first sac is found, if there is another one, it will appear when the patient is directed to cough. In every hernia opera-

tion the index finger should be passed through the ring, and the peritoneum carefully examined for weak spots in the abdominal wall or for beginning hernias. Eisendrath found pantaloonsacs four times in 100 operations for inguinal hernia.

4. **Postoperative Rest.**—The average hernia patient insists on getting up too soon after his operation, and does not take a sufficient amount of rest before returning to his work. Patients who have had operations for recurrent or direct hernias should avoid any kind of heavy work. Often they should be advised to change their occupation.

5. **Poorly Developed Musculature.**—Deficient muscular development favors recurrence, especially in direct hernia. Dowden advised systematic exercises to develop the muscles and lessen recurrence. He advised carrying out the exercises once daily for a month before operation, and resuming them two weeks after operation.

Turner (P.) called attention to the secondary weakness of the muscles and fascia, caused by pressure from the hernia, as an important factor favoring recurrence. When the deep sutures are tied at the primary operation under tension, if they do not pull loose from Poupart's ligament they have a tendency to stretch and weaken the structures covering Hesselbach's triangle, thus favoring the occurrence of direct hernia.

6. **Obesity.**—The obese patient is more liable to recurrence than the thin subject, because the adipose tissue causes a weakening and thinning of the muscles; and the intraabdominal tension, which is high before operation, increases as the patient takes on weight after the operation.

7. **The Blood Supply.**—The unnecessary cutting of blood vessels is to be avoided, as it interferes with the nutrition of the tissues during the process of repair. Cubbins called attention to the ill effects that may follow a too extensive dissection of the upper and under surfaces of the flaps of aponeurosis of the external oblique.

8. **Division of the Nerves.**—The iliohypogastric and ilioinguinal nerves supply the muscles in the inguinal region, and if they are divided, the weakened muscles atrophy and bulge, and recurrence is probable. The preservation of the iliohypogastric nerve is especially important, as it supplies the internal ring.

9. **Suture Material as a Cause of Recurrence.**—Recurrence is frequently due to the use of nonabsorbable sutures that irritate the tissues and cause suppuration or sinus formation in the wound. Silk, linen, silkworm-gut, and wire should never be used for the deep sutures. The only suture materials that should be used beneath the skin are catgut and kangaroo tendon. There was some excuse for the use of nonabsorbable sutures years ago when it was difficult to sterilize absorbable sutures, but there is none now.

Time of Recurrence in Oblique Inguinal Hernia.—When recurrence takes place, it usually occurs within the first few weeks after operation.

Erdman reported 978 traced cases of inguinal hernia, in patients operated upon at the New York Hospital, with recurrences in 73 as follows:

	OPERATIONS	TOTAL RECURRED	RECURRENCE FIRST NOTED				TOTAL WITHIN 2 YRS.
			WITHIN 6 MO.	BETWEEN 6-12 MO.	BETWEEN 12-18 MO.	BETWEEN 18-24 MO.	
Oblique	665	21	10	6	2	2	20 (95.2 %)
Direct	313	52	25	13	10	4	52 (100 %)
Total	978	73	35 (47.9 %)	19 (73.9 %)	12 (90.4 %)	6 (98.6 %)	72 (98.6 %)

Point of Recurrence after Bassini Operation for Oblique Hernia.—Oblique inguinal hernias most frequently recur through the opening left for the cord; occasionally they come through the deep suture line just above the pubis, and rarely through the middle of the deep suture line or a weak spot in the muscles or fascia. Burian reported 62 hernias that recurred after the Bassini operation. In 25 the hernia came through the opening left for the cord, while in 37 it appeared in the deep suture line.

Percentage of Recurrence in Oblique Inguinal Hernia.—The number of oblique inguinal hernias that recur following operation varies from 1 to 10 per cent depending on the age of the patient, and the choice of operation. Recurrence is lowest in those patients between the ages of 10 and 45 years.

Coley and Hoguet stated that in 3,725 operations by the Bassini method, there was .38 per cent of recurrence, while in 792 operations in which the cord was not transplanted there was 1.3 per cent recurrence. Schwartz (J.) examined 207 patients one to eleven years after operation for inguinal hernia by the Bassini method, and found 11 recurrences (5.3 per cent).

Ricketts collected from the literature 6,027 operations for inguinal hernia performed by 34 surgeons. In this series there was a recurrence of 5.58 per cent. Galeazzi reported 1,334 operations by the Bassini method with a recurrence of 2.16 per cent. Oudard and Jean collected from the French navy surgical records, 183 cases of recurrent hernia; these were all nonstrangulated inguinal hernias operated on by various methods, and the percentage of recurrence ranged from 1 to 10 per cent.

Percentage of Recurrence in Direct Hernia.—The percentage of recurrence in direct hernia operations is 10 to 20 per cent in the hands of the most experienced operators. Many surgeons report it to be between 25 and 50 per cent.

Russell examined 14 patients who had been operated on for very large inguinal hernia by rectus transplantation, two and a half to three and a half years previously. He found only two patients with recurrence, and one of these had had two previous operations.

Laméris reported 511 oblique hernia operations by the Bassini method with 20 (3.9 per cent) recurrences; in 102 direct hernia operations by the Bassini method, he found 29 (28.4 per cent) recurrences.

Davis (L.) reported 1,500 hernia operations at the Massachusetts General Hospital. Of these he traced 754, and found 8 per cent of recurrences; of the 75 operations done under local anesthesia, there was only 2 per cent of recurrences. In 88 direct hernias, 15 per cent recurred. He believed the most important causes of recurrence were cough, hematoma and sepsis.

Masson reported 7,016 operations at the Mayo Clinic. When the cord was transplanted there was less than 1 per cent of recurrences; when it was not transplanted the recurrence was over 1 per cent.

Mortality Rate Following Operation for Nonstrangulated Hernia.—In 8,000 operations for nonstrangulated inguinal hernia in adults, I collected from the literature, there were 30 deaths (.38 per cent).

Contraindications to Operation.—The following conditions usually contraindicate operation on reducible and nonstrangulated hernia: The acute infectious diseases, erysipelas, syphilis, pulmonary tuberculosis, emphysema, bronchitis, diabetes, advanced cardiovascular and renal disease, and acute urethritis. It is generally agreed by those who have had the most experience in pediatric surgery, that the operation for reducible hernia is not advisable in children under four years of age; unless truss treatment has been tried and failed or unless the hernia is one that cannot be retained by mechanical means.

Temporary contraindications to operation are infections, abrasions, and diseases of the skin in the inguinal region.

TREATMENT OF STRANGULATED INGUINAL HERNIA

The treatment of strangulated inguinal hernia is similar to the treatment of strangulated hernia elsewhere, and the same general principles apply to both children and adults. If the strangulation is recent, it is usually justifiable to try gentle taxis; if it has lasted from twelve to twenty-four hours, taxis is too dangerous, and only operative treatment should be considered.

Taxis.—Taxis is little used at the present time on account of the danger of returning gangrenous intestine to the abdominal cavity, and the chance of reducing the strangulation *en masse*. The directions for taxis are given, because the patient may refuse operation, his condition may not warrant it, and circumstances may be such that immediate operation is impossible. The method of taxis described by Cooper has never been improved; he directed that the bladder be emptied and the patient placed in the recumbent position with a pillow under his shoulders and another one under his hips; the thighs are elevated to a right angle with the body and the knees brought close together to relax the internal ring. The surgeon stands at the right side of the patient. With his right hand, he presses on the fundus of the hernia, and at the same time, with the index finger and thumb of the left hand, he gently moves the neck of the sac from side to side to aid reduction. If a part of the tumor can be reduced, the rest generally follows without difficulty.

The hernial contents that come down first lie in the front part of the sac, while those that come down last lie behind. For this reason the viscera in the posterior part of the sac should be reduced first.

The degree of force must be moderate, but continuous. Violent manipulations frequently rupture the intestine. The direction of pressure should be toward the anterior superior spine. Richter advises drawing down the sac to straighten out its neck, while making pressure. If the hernia cannot be reduced in five minutes, it is useless to continue taxis longer. Taxis is aided in infants and children by holding them by their feet, head downward. Inversion of the patient, as a means of reducing hernia, was practiced by the ancients; and revived after the Dark Ages by Guy de Chauliac.

Other measures that often aid taxis are: Hot baths, local applications of cold compresses, ice, ether or ethyl chlorid spray; in isolated cases hot applications are helpful.

Accidents of Taxis.—In case taxis fails, operation should be resorted to immediately, as there is always grave danger that the efforts of taxis may have ruptured the intestine. If taxis is apparently successful, the patient should be carefully watched for several hours for symptoms of laceration of the intestine, hemorrhage from the blood vessels of the omentum or mesentery, or reduction of the hernia *en masse*.

Signs of Reduction.—In reducing intestine and omentum, the intestine reduces first, with a gurgling sound. The patient often complains of pain, and children cry from it, especially when the hernia has been down for some time; and it is probably due to peristaltic contractions of the intestine set up by the manipulation of taxis. The omentum and mesentery are ordinarily difficult to reduce, and sometimes they are adherent to the sac, so that complete reduction is impossible. Cases of this type nearly always have a history of an old incompletely reducible hernia.

Strangulated Interstitial Hernia.—On account of the shortness of the sac and the comparatively large hernial opening, strangulation in properitoneal, interstitial, and inguinoperitoneal hernias is infrequent. When it does occur, it is often incomplete, and the symptoms are indefinite. When there is no tumor in the scrotum or labium majus, diagnosis may not be made until operation. Properitoneal hernias are commonly misdiagnosed as inguinal hernias strangulated *en masse*.

Vaughan observed a case in which a strangulated direct inguinal interstitial hernia passed upward between the peritoneum and the obturator fascia, and finally through the external ring. It was reducible, and at operation a coil of strangulated intestine was found in the bottom of the sac 3 inches (7.5 cm.) below the external ring behind the pubic bone. It was necessary to open the peritoneal cavity from above to reach the constriction. The intestine was viable, and the patient recovered.

Complications of Strangulated Hernia.—In addition to the changes that take place within the sac contents, strangulated hernia may be complicated by the following conditions: Ulceration of the skin over the sac, which may be followed by spontaneous rupture; laceration of the mesentery outside of the sac; rupture of intestine from external blows; lesions of viscera in the abdominal cavity; gangrene of the cord and testis, due to pressure of the hernia on the cord in neglected cases; and proximal ulceration of the intestine—a condition of more importance than is generally supposed.

I observed a case in which the strangulation had lasted for three days. Taxis had been attempted, and the skin was lacerated and so edematous and ecchymosed that it resembled a large superficial abscess. On opening the mass under local anesthesia, I found that the trauma of taxis had ruptured the aponeurosis of the external oblique. The contents of the sac, which consisted of most of the small intestine and part of the ascending colon were gangrenous.

Brown observed a man, aged 60, with strangulated inguinal hernia of less than 24 hours' duration. He died the following day from acute hemorrhagic pancreatitis.

Multiple Strangulation.—Two or more hernias may be strangulated in the same patient at the same time. Seigliano observed the case of a man, aged 50, with simultaneous strangulation of an oblique and direct hernia on the same side. Other cases of multiple strangulation are reported in the literature, but the condition is very rare.

Proximal Ulceration of Intestinal Obstruction.—The importance of inspecting the intestine above the point of constriction for solitary perforation or ulceration must be borne in mind in every case of strangulated hernia, even though the intestine is apparently viable. If the ulceration is overlooked at operation, perforation may occur hours afterwards, resulting in peritonitis and death. Kocher and Sellenings have written at length on this subject.

Division of the Constriction.—The old method of blindly dividing the constriction after pushing a grooved director through the internal ring alongside the neck of the sac should never be used on account of the danger of hemorrhage, and the possibility of the strangulation being in the sac itself; and besides, it is of the utmost importance to open the sac, so that the contents can be dealt with.

The correct method is to open the sac, as described for the regular operation for inguinal hernia, follow it upward to the internal ring, locate the constriction, and cautiously divide it as it is pulled down into plain view by forceps applied to each edge of the cut sac. In this way there is little danger of dividing the deep epigastric artery, but if it is accidentally cut, it is easy to pick up the bleeding ends and ligate them. In oblique hernia the

constriction should be divided upward and outward; in the direct variety it should be divided upward and inward.

When it is impossible to determine the position of the deep epigastric artery, the safest plan is to open the peritoneum above the constriction—a procedure that should also be resorted to when the swelling is so tense that it is impossible to introduce a director between the constricting ring and the sac. The danger of wounding the bladder must always be thought of, especially in direct hernias.

Robins' Operation for Strangulated Hernia.—Robins opened the sac, made a lateral rectus incision above the hernia, dilated the constricting ring with his finger and reduced the strangulated omentum and intestine quickly and easily. The operation is completed in one-fourth the time ordinarily required, an important factor in reducing the mortality rate in seriously ill patients. If there is gangrene, the intestine is resected or an artificial anus is formed. If the patient's condition is critical, the repair of the hernia is done at a second operation.

Treatment of Strangulated Intestine.—After all constricting bands are freed, the intestine should be wrapped in hot compresses, tested for viability, and carefully examined for gangrenous or necrotic spots. If gangrene is extensive, intestinal resection is indicated; if it is limited to a narrow band around the caliber of the intestine, it can often be invaginated into the healthy portion of the loop and the healthy edges closed over the gangrenous intestine.

If the necrotic spots are small, not over one-half inch (1.25 cm.) in diameter, the gangrenous area can be inverted and healthy serosa sewed over it, care being taken not to produce too much narrowing of the lumen of the intestine. Whatever method is used, a piece of omentum should be tacked over the line of suture to prevent leakage and the formation of adhesions.

The radical operation for the repair of the hernia should follow the treatment of the strangulated sac contents, if the condition of the patient permits. When the wound has been contaminated by septic sac contents, it is sometimes possible to limit the infection to a small area if three or four sutures are passed through the subcutaneous tissues, including a deep bite in the aponeurosis so as to close all dead spaces. These sutures can be placed about an inch (2.5 cm.) apart from above downward.

Strangulation Following Operation for Hernia.—In very rare instances, when the internal ring has not been sufficiently narrowed, intestine may pass through the opening and become strangulated when the patient gets up and walks. A case of this kind was observed by Thomas (T. T.).

Intrasaccular Strangulation.—Constricting bands inside of the hernial sac sometimes cause strangulation. They may be due to inflammation or to narrow points in the unobliterated processus vaginalis. Clough observed an interesting case of strangulation due to constriction in the tunica vaginalis near the testis. Moscheowitz reported 3 similar cases, and I have recently ob-

served one. Turner (G. G.) reported a scrotal hernia that was strangulated by a fibrous band in the sac, situated six inches (15 cm.) below the external ring, that was not derived from a Meckel's diverticulum or from the mesentery. A number of cases have been reported in the literature. The condition is common in umbilical hernia.

Mortality in Strangulated Hernia.—The mortality in strangulated hernia varies from 15 to 50 per cent, depending on the promptness with which operation is resorted to, the age and general condition of the patient, the method of operation, and the choice of anesthetic.

Simple reduction of the intestine before gangrene develops, has the most favorable prognosis. When there is gangrene, the mortality is lowest when only omentum is involved; is higher when resection of small intestine is required; and highest, when partial excision of the colon is necessary. (See chapter on strangulated hernia.)

The greatest factor in reducing the mortality in strangulated hernia, is the use of local anesthesia and the employment of the two-stage operation in border-line cases.

Bibliography

INGUINAL HERNIA—TREATMENT

- AGUILAR, J.: Curación radical de la hernia inguinal por el método operativo del Dr. J. Aguilar. *Revista del Centro Estudiantes de Medicina*, 1905, iv, 81-86.
- ALLEN, C. W.: Discussion: South. M. J., Birming., 1911-1912, iv, 429.
- ANDREWS, E. W.: Imbrication or lap joint method; a plastic operation for hernia. *Chicago M. Rec.*, 1895, ix, 67-77.
- ANNANDALE, T.: Case in which a reducible oblique and direct inguinal and femoral hernia existed on the same side, and were successfully treated by operation. *Edinb. M. J.*, 1875-1876, xxi, 1087-1091.
- ARNAUD, G.: A dissertation on hernias or ruptures. London, A. Millar, 1748, p. 147-154.
- BALL, C. B.: The radical cure of hernia by torsion of the sac. *Brit. M. J., Lond.*, 1884, ii, 461-462.
- BANKS, W. M.: On the radical cure of hernia, by removal of the sac and stitching together the pillars of the ring. *Brit. M. J., Lond.*, 1882, ii, 985-988.
- BARKER, A. E.: On thirty-five operations for the radical cure of hernia by original methods. *Brit. M. J. Lond.*, 1884, ii, 1203-1205.
- BARTLETT, W.: An improved filigree for the repair of large defects in the abdominal wall. *Ann. Surg., Phila.*, 1903, xxxviii, 47-62.
- BASSINI, E.: Sopra 100 casi di cura radicale dell' ernia inguinale, operata con metodo dell' autore. *Ital. chir. congr., Napoli*, 1888.
- BASSINI, E.: Ueber die Behandlung des Leistenbruches. *Arch. f. klin. Chir., Berl.*, 1890, xl, 429-476.
- BATES, U. C.: New operation for the cure of indirect inguinal hernia, *J. Am. M. Assn., Chi.*, 1913, lx, 2032-2033.
- BAXTER, G. A.: A proposed new method of operating for the radical cure of inguinal hernia. *Ann. Surg., Phila.*, 1893, xvii, 263-268.
- BÉGOUIN, P.: Du procédé de Mugnai dans la cure radicale de la hernie inguinale. *J. de méd. de Bordeaux*, 1903, xxxiii, 581.
- BENNETT, C.: The "darn and stay-lace" method for the radical cure of inguinal hernia. *Practitioner, Lond.*, 1918, ci, 114.
- BENNETT, W. H.: On the radical cure of hernia, with especial reference to certain methods of operating. *Lancet, Lond.*, 1891, ii, 599-601; 648-650.
- BÉRARD, L.: See Michallon, A.: Sur un procédé de cure radicale de l'ectopie testiculaire inguinale avec hernie. Thèse, Lyon, 1904.

- BERGER, P.: La hernie inguino-interstitielle et son traitement. *Rev. de chir., Par.*, 1902, xxv, 1-50.
- BEVAN, A. D.: Operation for undescended testicle and congenital inguinal hernia. *J. Am. M. Assn., Chi.*, 1899, xxxiii, 773-777.
- BEVAN, A. D.: The surgical treatment of undescended testicle. *J. Am. M. Assn., Chicago*, 1903, xli, 718-724.
- BEVAN, A. D.: Undescended testes. *Surg. Clin. Chi.*, 1918, ii, 1101-1117.
- BISHOP, E. S.: The radical cure of hernia. *Lancet, Lond.*, 1890, i, 1169-1236.
- BLAKE, J. A.: The relative bearing of the conjoined tendon and the internal oblique muscle upon the radical cure of inguinal hernia. *Med. Rec., N. Y.*, 1900, lviii, 321-324.
- BLAKEY: See Macready, J. F. C. H.: p. 196.
- BLOODGOOD, J. C.: The transplantation of the rectus muscle in certain cases of inguinal hernia in which the conjoined tendon is obliterated. *Johns Hopkins Hosp. Bull., Balt.*, 1898, ix, 96-100.
- BLOODGOOD, J. C.: Intestinal obstruction following operation for reducible left inguinal hernia due to a loop of small intestine caught in Treitz's fossa. *Ann. Surg., Phila.*, 1903, xxxviii, 806-811.
- BLOODGOOD, J. C.: The transplantation of the rectus muscle or its sheath for the cure of inguinal hernia when the conjoined tendon is obliterated. [etc.] *Ann. Surg., Phila.*, 1919, lxx, 81-88.
- BOTTINI, E.: Di un nuovo processo nella cura radicale delle ernie. *Riforma med., Napoli*, 1891, vii, pt. 4, p. 265-266.
- BRENNER, A.: Zur Radicaloperation der Leistenhernien. *Centralbl. f. Chir., Leipz.*, 1898, xxv, 1017-1023.
- BROWN, W.: Notes on a case of strangulated hernia associated with acute hemorrhagic pancreatitis. *Lancet, Lond.*, 1907, i, 806.
- BUCHANAN, G.: Operation for the radical cure of congenital inguinal hernia in the child. *Brit. M. J., Lond.*, 1879, i, 735.
- BURIAN, F.: La cure radicale de la hernie inguinale. *Rev. de chir., Par.*, 1919, lvii, 222-228.
- CALVERLEY, J. E. G.: The association of atrophy of the testicle and inguinal hernia. *Lancet, Lond.*, 1917, i, 277.
- CELSUS, A. C.: Of Medicine. English transl. by J. Grieve, Lond., Wilson & Durham, 1756, 432-435.
- CHATTERJEE, K. K.: A modified Bassini operation for hernia. *Indian M. Gaz., Calcutta*, 1919, liv, 174-175.
- CHAULLAC, GUY DE: Chirurgiæ Magnæ. Veniitis, Iuntas, 1596, p. 126-127.
- CHEATLE, G. L.: An operation for inguinal hernia. *Brit. M. J., Lond.*, 1921, ii, 1025-1026.
- CHEYNE, W. W.: The treatment of incompletely descended testicle. *Brit. M. J., Lond.*, 1890, i, 351-352.
- CLOUGH, F. E.: An unusual strangulated inguinal hernia. *J. Am. M. Assn., Chi.*, 1909, liii, 1482.
- COHEN, H.: The combined right inguinal hernia appendix operation. *N. York M. J.*, 1921, cxiv, 343-344.
- COLEY, W. B.: Hernia. *Progr. Med., Phila.*, Lea & Febiger, [Technique of operative cure of abdominal hernia], 1914, ii, 30. [Silver wire and linen thread for cure of hernia], 1911, ii, 17-26.
- COLEY, W. B.: Treatment of hernia in infancy and childhood. *Progr. Med., Phila.*, Lea & Febiger, 1915, ii, 18.
- COLEY, W. B.: Operative treatment of undescended or maldescended testis with especial reference to end-results. *Surg. Gynec. & Obst., Chi.*, 1919, xxviii, 452-459.
- COLEY, W. B. AND HOGUET, J. P.: Operative treatment of hernia. *Ann. Surg., Phila.*, 1918, lxxviii, 255-268.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.
- CRAMP, W. C.: Unusual result of truss wearing; case report. *Am. J. Surg., N. Y.*, 1912, xxvi, 279.
- CUBBINS, W. R.: A contribution to the surgery of hernia. *Surg. Gynec. & Obst., Chi.*, 1911, xiii, 682-683.
- CUNNINGHAM, J. H.: New growths developing in undescended testicles. *J. Urology, Balt.*, 1921, v, 471.
- CZERNY, V.: Studien zur Radikalbehandlung der Hernien. *Wien. med. Wchnschr.*, 1877, xxvii, 497-500; 527-530; 553-556; 578-581.
- DAVIES, W. T. F.: A method of operating for radical cure of inguinal hernia. *Brit. M. J., Lond.*, 1913, ii, 727-728.

- DAVIS, G. G.: The radical cure of direct inguinal hernia. *Ann. Surg., Phila.*, 1906, xliii, 111-113.
- DAVIS, G. G.: Applied anatomy, 5th ed., Phila. and Lond., Lippincott, 1918, 389.
- DAVIS, L.: Complications and sequelae of the operation for inguinal hernia. *J. Am. M. Assn., Chi.*, 1916, lxvii, 480-483.
- DE GARMO, W. B.: Abdominal-hernia. New York, Lippincott, 1907.
- DEHELLEY, G.: A new procedure for treating the sac in inguinal hernia. *Internat. Clin., Phila.*, 1919, 29 s, ii, 293-294.
- DE TARNOWSKY, G.: Appendectomy through the right inguinal canal. *J. Am. M. Assn., Chi.*, 1915, lxv, 1548-1549.
- DOWD, C. N.: Preservation of the iliohypogastric nerve in operation for cure of inguinal hernia. *Ann. Surg., Phila.*, 1915, lxi, 204-208.
- DOWDEN, J. W.: The rôle of the abdominal muscles in relation to hernia. *Scot. M. & S. J., Edinb.*, 1903, xiii, 408-410.
- DOWNES, W. A.: Cases illustrating the use of the rectus muscle in direct inguinal hernia. *Ann. Surg., Phila.*, 1911, liii, 568-571.
- DOWNES, W. A.: Management of direct inguinal hernia. *Arch. Surg., Chi.*, 1920, i, 53-73.
- DUPLAY, S., AND CAZIN, M.: Sur un nouveau procédé de cure radicale des hernies inguinales sans fils perdus. *Semana méd., Buenos Aires*, 1896, xvi, 453-454.
- DURINGER, W. A.: Modified Halsted's and Bassini's operation for inguinal hernia. *Texas State J. M., Fort Worth*, 1909-1910, v, 219-220.
- EARL, G.: A modified inguinal hernia technic. *J. Minn. M. Assn., Minneap.*, 1920, iii, 342-345.
- EDMUNDS, A.: Double inguinal hernia; operation through a single incision. *Med. Press and Circ., Lond.*, 1908, n. s. lxxxv, 348.
- EISENDRATH, D. N.: Rare variety of hernia sac. *J. Am. M. Assn., Chi.*, 1910, liv, 1049.
- ELKOURIE, H. A.: Why ligate the sac in hernia? *South. M. J., Birmingham*, 1912, v, 158-161.
- ERDMAN, S.: Inguinal Hernia in the Male, *Ann. Surg., Philadelphia*, 1923, lxxvii, 171-189.
- ERDMANN, J. F.: Accidents in hernia operations, with especial reference to the vessels. *Ann. Surg., Phila.*, 1909, xlix, 208-217.
- ESTOR, E.: Un nouveau procédé de cure radicale de la hernie inguinale par occlusion partielle du canal inguinal et réduction de ses dimensions à celles du cordon spermatique. *Semana méd., Buenos Aires*, 1903, xxiii, 69-71.
- FAGGE, C. H.: Retroperitoneal hematoma after radical cure of inguinal hernia and varicocele. *Brit. J. Surg., Bristol*, 1920, vii, 542-543.
- FAURE, J. L.: Sur un nouveau procédé de cure des hernies sans fils perdus. *Presse méd., Par.*, 1898, i, 49-50.
- FÉLIZET, G. M.: La cure radicale des hernies particulièrement chez les enfants. *Paris, Masson*, 1890.
- FERGUSON, A. H.: Oblique inguinal hernia; typic operation for its radical cure. *J. Am. M. Assn., Chi.*, 1899, xxxiii, 6-14.
- FERGUSON, A. H.: Modern operations for hernia. Chicago, Cleve'and Press, 1907.
- FERRARI, P.: Per la cura radicale dell'ernia inguinale. *Gaz. d. osp., Milano*, 1895, ii, 1396.
- FINOCHIETTO, E., AND SQUIRRU, C. M.: Clasificación y descripción de un variedad de hernia inguinal mixte. *Prensa méd. Argentina, Buenos Aires*, 1917-18, iv, 191.
- FIGORE, G.: Sull'uso dei fili d'oro nell'operazione radicale dell'ernia inguinale. *Riforma med., Napoli*, 1900, iii, 580-581.
- FOBES, J. H.: Modern technique in hernia operations. *Am. J. Surg., N. Y.*, 1919, xxxiii, 248-250.
- FOURNEL, C.: Cure radicale opératoire de la hernie inguinale avec un nouveau procédé. *Paris, A. Maloine*, 1900.
- FOWLER, G. R.: A new method for the radical cure of inguinal hernia. *Ann. Surg., Phila.*, 1897, xxvi, 603-623.
- FRANK, L.: Notes on abdominal hernia. *Am. J. Surg., N. Y.*, 1922, xxxvi, 1.
- FRANK, R.: Verschluss des Bruchsackes mit autoplastischen Knoten. *Zentralbl. f. Chir., Leipz.*, 1922, xlix, 288-289.
- FRANKS, K.: The radical cure of hernia by the method of dissection. *Brit. M. J., Lond.*, 1887, ii, 1202-1203.
- FRIEND, E.: The disposition of the sac in hernia. *J. Am. M. Assn., Chicago*, 1919, lxxiii, 13-14.
- GALEAZZI, R.: I risultati definitivi nella cura operativa dell'ernia inguinale. *Clin. chir., Milano*, 1899, vii, p. 497-510; 577-592; 657-664.
- GALLIE, W. E., AND LE MESURIER, A. B.: The use of living sutures in operative surgery. *Canad. M. Assn. J., Toronto*, 1921, xi, 504-513.

- GARDINER, J. P.: Pregnancy complicated with hernia. Boston M. & S. J., 1916, clxxv, 637-639.
- GATINARIA, M.: See Macready, J. F. C. H.: p. 195.
- GIRARD: Sur la cure radicale de la hernie inguinale. Tr. XIII Internat. M. Cong., sect. de chir. gén., Paris, 1900, Paris, 1901, 431-434.
- GOODWIN, H. T.: A new operation for congenital hernia. N. York M. J., 1894, lix, 498.
- GORDON: See Macready, J. F. C. H.: p. 195.
- GRIFFITHS, J.: The effects upon the testes of ligature of the spermatic veins, and of both artery and veins. J. Anat. & Physiol., Lond., 1896, n.s., x, 81-105.
- HALSTED, W. S.: The radical cure of inguinal hernia in the male. Johns Hopkins Hosp. Bull., Balt., 1893, iv, 17-24.
- HALSTED, W. S.: The operative treatment of hernia. Am. J. M. Sc., Phila., 1895, ex, 13-17.
- HALSTED, W. S.: The cure of the more difficult as well as the simpler inguinal ruptures. Johns Hopkins Hosp. Bull., Balt., 1903, xiv, 208-214.
- HANDLEY, W. S.: A method for the radical cure of inguinal hernia (darn and stay-lace method). Practitioner, Lond., 1918, c, 466-471.
- HESSERT, W.: Recurrences following operations for inguinal hernia. Surg. Gynec. & Obst., Chi., 1922, xxxv, 431-436.
- HOGUET, J. P.: The nerve supply of the anterior abdominal wall and its surgical importance. Ann. Surg., Phila., 1911, liv, 153-159.
- HOGUET, J. P.: Right inguinal hernia following appendectomy. Ann. Surg., Phila., 1911, liv, 673-676.
- HOGUET, J. P.: Observations on Two Thousand Four Hundred and Sixty Eight Hernia Operations by One Operator. Surg., Gynec., and Obst., xxxvii, 71-75.
- HOGUET, J. P.: Direct inguinal hernia. Ann. Surg., Phila., 1920, lxxii, 671-674.
- HOTCHKISS, L. W.: Observations on the treatment of direct inguinal hernia in adults. Ann. Surg., Phila., 1918, lxxviii, 214-216.
- HULL, A. J.: Recurrence of inguinal hernia. Ann. Surg., Phila., 1913, lviii, 479-482.
- HUME, D. W.: Ilio-tibial band grafts for the radical cure of large inguinal herniae. Brit. M. J., Lond., 1921, ii, 824.
- JUDD, E. S.: A single transverse incision for use in double inguinal herniotomies. Old Dominion J. M. & S., Richmond, 1913, xvi, 153-156.
- KELLY, H. A.: Operative gynecology. 2nd ed. New York, Appleton, 1909, ii, 593-599.
- KINGSCOTE, E.: On the radical cure of hernia. Brit. M. J., Lond., 1890, i, 1482.
- KIRBY, H. H.: Inguinal hernia. J. Arkansas M. Soc., Little Rock, 1918, xv, 99-104.
- KIRSCHNER, M.: Die praktischen Ergebnisse der freien Fascien-Transplantation. Arch. f. klin. Chir., Berl., 1910, xcii, 888-912.
- KOCHER, T.: Zur Radicalcur der Hernien. Cor. Bl. f. schweiz. Aerzte, Basel, 1892, xlii, 561-576.
- KOCHER, T.: Ueber ileus. Mitt. a. d. Grenzgeb. d. Med. u. Chir., Jena, 1898-1899, iv, 195-230.
- KRASKE, P.: Ueber die Radikaloperation bei angeborenen Leistenbrüchen der Männer. Centralbl. f. Chir. Leipz., 1882, ix, 425-432.
- KRASKE, P.: Zur Frage von den Nothwendigkeit der Ablatio testis in einzelnen Fällen von Radikaloperation bei Scrotalhernien. Centralbl. f. Chir., Leipz., 1883, x, 1-5.
- LAMÉRIS, H. J.: Zur Behandlung der indirekten Leistenhernie, Deutsche Ztschr. f. Chir., Leipz., 1912, cxix, 569-580.
- LANDERER, A.: Ueber plastische Herniotomie. Arch. f. klin. Chir., Berl., 1891, xlii, 879-881.
- LAROCQUE, G. P.: The permanent cure of inguinal and femoral hernia; a modification of the standard operative procedures. Surg. Gynec. & Obst., Chi., 1919, xxix, 507-510.
- LE DENTU, A.: Exposé d'un procédé spécial de cure radicale des hernies inguinales. Rev. de chir., Par., 1900, xxii, 731-738.
- LEE, W. E.: Gastro-intestinal hemorrhage following radical operation for hernia. Ann. Surg., Phila., 1908, xlviii, 632-633.
- LENORMANT, C.: L'emploi des greffes aponévrotiques et périostiques dans la cure radicale des hernies volumineuses. Presse méd., Par., 1912, xx, 84-85.
- LEONTÉ: Procédé nouveau de cure radicale des hernies. Rev. de chir., Par., 1888, viii, 274-275.
- LEQUIN, A.: Le chirurgien herniaire. Paris, d'Houry, 1797.
- LEXER, E.: See Young, H. M.: Methods of dealing with the sac in operations for the radical cure of inguinal and femoral herniae. Interstate M. J., St. Louis, 1911, xviii, 1018-1025.
- LIPSITZ, B.: Malignancy of the undescended testis; associated with hydrocele. Ann. Surg., Phila., 1922, lxxvi, 260-271.
- LONG, L.: Harmful use of cathartics after abdominal operations. Surg. Gynec. & Obst., Chi., 1922, xxxv, 658-660.
- LUCAS-CHAMPIONNIÈRE, J.: Chirurgie opératoire. Cure radicale des hernies; avec une étude statistique de deux cents soixante-quinze opérations. Paris, Rueff et Cie, 1892.

- LUCAS-CHAMPIONNIÈRE, J.: See Segond, P.: Cure radicale des hernies. Thèse de concours, Paris, 1883.
- LUCAS-CHAMPIONNIÈRE, J.: Sur la cure radicale des hernies. Bull. et mém. Soc. de chir. de Par., 1887, xiii, 737-742.
- LUCAS-CHAMPIONNIÈRE, J.: Conditions de solidité des résultats de l'opération de la cure radicale de la hernie. Bull. Acad. de méd., Par., 1897, xxxviii, 140-154.
- LUCAS-CHAMPIONNIÈRE, J.: La cure radicale de la hernie inguinale. Paris, G. Steinheil, 1909.
- LUCID, M. M.: An intraperitoneal method for the radical cure of abdominal hernias. Surg. Gynec. & Obst., Chi., 1908, vii, 568-572.
- LUSK, W. C.: Discussion on inguinal hernia. Ann. Surg., Phila., 1917, lxvi, 735-736.
- LYLE, H. H. M.: The value of position in the operative treatment of inguinal hernia. Surg. Gynec. & Obst., Chi., 1920, xxxi, 529-530.
- McBURNEX, C.: The radical cure of hernia, with special reference to open treatment of the operation wound. N. York M. J., 1888, xlvii, 57-61.
- McDONALD, E.: Disinfection of the hands and abdominal skin before operation. Surg. Gynec. & Obst., Chi., 1915, xxi, 82-86.
- McGAVIN, L.: The double filigree operation for the radical cure of inguinal hernia. Brit. M. J., Lond., 1909, ii, 357-363.
- McGAVIN, L.: Swelling of the lower extremity following Bassini's operation. Proc. Roy. Soc. Med., Lond., 1912-1913, vi, clin. sect., 207.
- McKENZIE R. T.: The value of exercises in treating certain cases of acquired inguinal hernia. Internat. Clin., Phila., 1912, 22, s. iii, 235-241.
- MACEWEN, W.: On the radical cure of oblique inguinal hernia by internal abdominal peritoneal pad, and the restoration of the valved form of the inguinal canal. Ann. Surg., Phila., 1886, iv, 89-119.
- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- MANN, A. T.: The free transplantation of fascia lata. Ann. Surg., Phila., 1914, lx, 481-484.
- MANN, A. T.: New methods of operating for difficult herniae. Journal-Lancet, Minneap., 1917, xxxvii, 331-337.
- MANTELLI, C.: Esiti lontani della plastica con sartorio nella cura di certe ernie inguinali. Gaz. d. osp., Milano, 1914, xxxv, 2023-2024.
- MARCY, H. O.: A new use of carbolized catgut ligatures. Boston M. & S. J., 1871, n. s. viii, 315-316.
- MARCY, H. O.: The cure of hernia by the antiseptic use of animal ligature. Tr. VII Internat. M. Cong., 1881, ii, 446-448.
- MARRO, A.: La cura delle ernie inguinali e crurali. Torino, Unione Tipografica, 1913.
- MASSON, J. M.: Recurring inguinal hernia. Minn. Med., St. Paul, 1919, ii, 373-382.
- MASSON, J. C.: Postoperative Ventral Hernia. Surg., Gynec. and Obst., 1923, xxxvii, 14-19.
- MERMINGAS: Zur Operationmethodik des schrägen Leistenbruchs. Zentralbl. f. Chir., Leipzig, 1920, xlvii, 850-852.
- MEYER, W.: The implantation of silver filigree for the closure of large hernial apertures. Tr. Am. Surg. Assn., Phila., 1902, xx, 362-373.
- MEYER, W.: The importance of posture in postoperative treatment. Surg. Clin. N. A., Phila., 1921, i, 283-305.
- MILLER, A. M.: Treatment of the sac in herniorrhaphy. Surg. Gynec. & Obst., Chi., 1919, xxix, 201.
- MILLOT, P.: De quelques modifications apportés à la cure radicale des hernies inguinales, chez l'homme procédé Bassini-Ferrari. Thèse, Paris, 1902.
- MITCHELL, J. H.: The extragenital chancre as a complication in minor surgery. Surg. Clin., Chi., 1918, ii, 341-351.
- MOLLIÈRE, D.: De la cure radicale des hernies. III Cong. franç. de chir. Proc.-verb. [etc.], Par., 1888, iii, 136-139.
- MONOD, C.: Orchidopexie. Bull. et mém. Soc. de chir. de Par., 1891, xvii, 475.
- MORESTIN, H.: La cure esthétique des hernies inguinales chez la femme. Presse méd., Par., 1903, xi, 2nd sem., 301-305.
- MORESTIN, H.: La cure esthétique des hernies. Rev. de gynec. et de chir. abd., Par., 1905, ix, 69-84.
- MORRIS, R. T.: Pain in scar following operation for hernia. Post-Graduate, N. Y., 1908, xxiii, 323-324.
- MOSCHICOWITZ, A. V., AND NEUHOF, H.: The relation of the iliohypogastric nerve to the radical cure of inguinal hernia. Ann. Surg., Phila., 1917, lxvi, 79-87.
- MUGNAI, A.: Nuovo processo per la cura radicale dell'ernie inguinale. Riforma med. Napoli, 1891, ii, 172-174.

- NÉLATON, C., AND OMBRÉDANNE, L.: Du passage transpubien du cordon dans la cure radicale des hernies inguinales et l'orchidopexie. *Presse méd.*, Par., 1897, v, 2nd sem., 50-51.
- NEUBERGER, H.: Die Operation nach Bassini ohne Ablösung des Bruchsacks vom Samenstrang. *Wien klin. Wehnschr.*, 1921, xxxiv, 512.
- NEUFFER, H.: Über eine Modifikation der Leistenbrüchen Operation nach Bassini-Hackenbruch. *Zentralbl. f. Chir. Leipz.*, 1922, xlix, 669-671.
- NEWMAN, E. A. R.: The operation of election for the radical cure of inguinal hernia. *Indian M. Gaz.*, Calcutta, 1914, xlix, 303-305.
- NICOLL, J. H.: Case operated on for radical cure of inguinal hernia. *Glasgow M. J.*, 1905, lxiv, 241-248.
- NOETZEL: Ueber Verwendung des Brennerschen Prinzips bei der Radikaloperation der Leistenhernien. *Verhandl. d. deutsch. Gesellsch. f. Chir.*, Berl., 1914, xliii, I, Teil, 28-32.
- NOTA, A.: Di un nuovo procedimento nella cura radicale dell'ernia inguinale nei bambini. *Policlin.*, Roma, 1914, xxi, sez. chir., 340-343.
- OCHSNER, A. J.: Surgical treatment of hernia in children. *St. Paul M. J.*, St. Paul, Minn., 1917, xix, 151-153.
- O'CONOR, J.: Radical cure of inguinal hernia. *Brit. M. J.*, Lond., 1914, ii, 115-116.
- OMBRÉDANNE, L.: De l'orchidopexie transrotale. *Presse méd.*, Par., 1910, xviii, 745-750.
- OUDAUD AND JEAN, G.: Hernies inguinales récidivées. *Rev. de chir.*, Par., 1922, lx, 143-180.
- PAGET, J.: Clinical lectures on strangulated hernia. *Lecture 3. Brit. M. J.*, Lond., 1872, i, 515-516.
- PANNETT, C. A.: The treatment of the imperfectly descended testicle, *Lancet*, Lond., 1921, ii, 379-382.
- PARONA, F.: Della cura radicale dell'ernia inguinale e di un nuovo methodo per ottenerla. Milano, 1892.
- PAYNE, M. J.: Improved technic for repair of inguinal hernia. *South. M. J.*, Birmingham, 1918, xi, 243-245.
- PETRULIS, S.: Einige Modificationen in der Radikaloperation der Leistenhernie. *Arch. f. klin. Chir.*, Berl., 1903, lxxi, 937-954.
- PHILIPS, A. M.: A new operation for hernia. *N. York M. J.*, 1894, lx, 291-296.
- PHILIPS, A. M.: The Phelps operation for hernia and method of closure of abdominal wounds. *Med. Rec.*, N. Y., 1900, lviii, 441-443.
- PÓLYA, E.: Beitrag zum plastischen Verschluss der Leistenbruchpforte. *Virchow's Arch. f. path. Anat.*, [etc.], Berl., 1913, cexiii, 504-507.
- PONCET, F.: Un bandage herniaire à l'époque phénicienne, d'après une terre cuite trouvée à Sousse (Hadrumete) et représentant le dieu Bès ou Bizon. *Le Progrès méd.*, Par., 1895, i, 358-361.
- POND, A. M.: The surgical treatment of large inguinal hernia. *Tr. West Surg. Assn.*, 1914, xxiv, 65-73.
- POSTEMPSKI, P.: Nuovo processo operativo per la cura radicale delle ernie inguinali. Roma, I, Artero, 1891.
- POULLET, J.: Cure radicale des hernies, même chez les vieillards, par méthode à lambeau fibro-périostique. *Arch. prov. de chir.*, Par., 1894, iii, 310-313.
- QUAIN, E. P.: The necessity of conserving the intercostal nerves in abdominal incisions: an experimental study. *Am. J. Surg.*, N. Y., 1914, xxviii, 133-139.
- RECLUS, P.: See Millot, P.
- REED, C. A. L.: A new operation for the radical cure of inguinal and femoral hernia. *N. York M. J.*, 1894, lx, 568.
- REVERDIN, J. L.: Deux opérations de cure dite "radicale" de hernies inguinales non étranglées; modification du manuel opératoire. *Bull. et mém. Soc. de chir. de Par.*, 1881, n. s. vii, 268-278.
- RIBAS Y RIBAS, E.: Obstrucción intestinal después de una cura radical de hernia inguinal. *Rev. de cien. méd. de Barcel.*, 1917, xliii, 411-412.
- RICHELOT, L. G.: Sur le traitement de l'ectopie testiculaire. *Bull. et mém. Soc. de chir. de Par.*, 1890, xvi, 274-287.
- RICHTER, A. G.: Abhandlung von den Brüchen. Göttingen, J. C. Dieterich, 1785.
- RICKETTS, B. M.: Inguinal hernia. *Am. Med.*, Burlington, Vt., 1901, i, 201-205.
- ROBINS, C. R.: Rectus incision for reduction of strangulated hernia, with report of a case of strangulated hernia in the sac of an undescended testicle. *Old Dominion J. M. & S.*, Richmond, 1909, viii, 324-326.
- RUSSELL, J. I.: Treatment of inguinal hernia, with special reference to the use of the rectus muscle. *Surg. Gynec. & Obst.*, Chi., 1906, ii, 553-555.

- SCANDOLA, C.: Intorno a due Casi di ernia operati da un anno Col metodo degli innesti artificiali profondi di cauceiu. *Gazz. d. osp.*, Milano, 1915, xxxvi, 661-662.
- SCHLEY, W. S.: The utilization of the external oblique aponeurosis in inguinal hernia with muscle deformity. *Ann. Surg.*, Phila., 1920, lxxi, 753-754.
- SCHLEY, W. S.: Transposition of the Rectus Muscles and the Utilization of the External Oblique Aponeurosis in the Radical Cure of Inguinal Hernia. *Ann. Surg.*, Philadelphia, 1923, lxxvii, 605-611.
- SCHOENBERG, A. J.: Improved technic for removal of collapsed vulvovaginal and other cysts and hernial sacs. *Surg. Gynec. & Obst.*, Chi., 1910, x, 309-310.
- SCHRAGER, V. L.: Routine appendectomy through right indirect inguinal hernial sac in afebrile cases. *Surg. Clin.*, Chi., 1919, iii, 387-389.
- SCHWARTZ, E.: Sur un procédé de cure radicale des hernies et en particulier des hernies crurale et inguinale; myoplastie herniaire. *Cong. franç. de chir. Proc.-verb. [etc.]*, Par., 1893, vii, 689-693.
- SCHWARTZ, J.: Zur Frage der Rezidive nach Bassini. *Zentralbl. f. Chir.*, Leipz., 1922, xlix, 476-479.
- SCIGLIANO, S.: Ernia inguinale esterna ed ernia inguinale diretta dello stesso lato, strozzato contemporanea mente. *Riforma med.*, Napoli, 1921, xxxvii, 985.
- SCOTT, A. C.: The radical cure of inguinal hernia. *Texas State J. M.*, Fort Worth, 1919-1920, xv, 5-6.
- SCUDDER, C. L.: An operation for inguinal hernia. *Ann. Surg.*, Phila., 1905, xli, 76-80.
- SEEVER, J. W.: The treatment of inguinal hernia by exercise. *Yale M. J.*, N. Haven, 1903-1904, x, 277-284.
- SELLENINGS, A. E.: Solitary perforation of the ileum (proximal ulceration of intestinal obstruction) associated with strangulated and obstructed herniae; report of two cases with recovery. *Am. J. Surg.*, N. Y., 1910, xxiv, 321-323.
- SELLENINGS, A. E.: The treatment of the sac in inguinal hernia. *N. York M. J.*, 1915, ci, 952-954.
- SKILLERN, P. G.: The choice of operation in inguinal hernia. *Surg. Gynec. & Obst.*, Chi., 1922, xxxiv, 230-237.
- SLAJMER, E.: Bericht über 150 Radicaloperationen des freien Leistenbruches nach Wölfler. *Arch. f. klin. Chir.*, Berl., 1898, lvi, 893-923.
- SLATTERY, R. V.: An operation for the radical cure of inguinal hernia. *Lancet*, Lond., 1917, ii, 455.
- SOCIN, A.: Ueber Radicaloperation der Hernien. *Arch. f. klin. Chir.*, Berl., 1879, xxiv, 391-398.
- SOCIN, A.: De la valeur de la cure radicale des hernies au point de vue de la guérison définitive. *Rev. de chir.*, Par., 1888, viii, 264-266.
- SOUBEYRAN, P.: La reconstruction d'une bonne paroi dans la cure radicale de la hernie artificielle profonde di cauceiu. *Gaz. d. osp.*, Milano, 1915, xxvi, 661-662.
- SOUBEYRAN, P.: La reconstitution d'une bonne paroi dans la cure radicale de la hernie inguinale. (Procédé antefuniculaire.) *Par. méd.*, 1917, xx, 234-239.
- SPANTON, W. D.: On the cure of hernia in relation to parents and the profession. *Tr. VII Internat. M. Cong.*, 1881, ii, 448-451.
- SQUIRRI, C. M.: La hernia inguinal simple. *Tesis*, Buenos Aires, 1915.
- STETTEN, D.: Modified technic for the radical cure of inguinal hernia in the male. *Ann. Surg.*, Phila., 1920, lxxi, 744-752.
- STETTEN, D.: Further Observations on a Modified Inguinal Hernioplasty Technic, with Completed Utilization of the Aponeurosis of the External Oblique. *Ann. Surg.*, Philadelphia, 1923, lxxviii, 48-60.
- STOKES, W.: On the radical cure of hernia by peritoneal and intercolumnar suture. *Dublin J. Med. Sc.*, 1884, lxxvii, 97-104.
- STREISSLER, E.: Myoplastik bei grossen Leistenhernien. *Beitr. z. klin. Chir.*, Tübing., 1909, lxii, 433-442.
- SWIFT, E. L.: A new form of operation for the cure of inguinal hernia. *N. York M. J.*, 1897, lxvi, 553-555.
- TADDEI, D.: L'eversione del fondo dei sacchi erniari inguino scrotali aderenti. *Riforma med.*, Napoli, 1921, xxxvii, 489.
- TAIT, L.: On the radical cure of exomphalos. *Brit. M. J.*, Lond., 1883, ii, 1118-1119.
- TAYLOR, A. S.: The results of operations for inguinal hernia. *Arch. Surg.*, Chi., 1920, i, 382-406.
- TAYLOR, E. H.: *Operative surgery*. Lond., Churchill, 1914, p. 211-214.
- TERRILLON, O. R. S.: Cure radicale des hernies. *Bull. gén. de therap. [etc.]*, Par., 1889, cxvi, 145-150.

- THIRIAR, J. A.: Utilité d'un transplant osseux dans la cure radicale des hernies. Cong. franç. de chir. Proc. verb. (etc.), Par., 1893, vii, 318-323.
- THOMAS, T. T.: Strangulation of an inguinal hernia following a Halsted operation. *Ann. Surg., Phila.*, 1921, lxxiii, 641.
- THOMSON, C. E.: Treatment of hernia (discussion). *Penn. M. J., Athens*, 1913, xvi, 375-376.
- TOREK, F.: Combined operation for the removal of the appendix and the cure of inguinal hernia. *Ann. Surg., Phila.*, 1906, xliii, 665-667.
- TRENDELENBURG: See Graser, E.: Hernia. *In: A system of practical surgery. Bergmann-Bruns-Mikulicz. English transl. ed. by W. T. Bull. Phila., Lea Bros.*, 1904, iv, 516.
- TUFFIER, T.: Traitement chirurgical de l'ectopie testiculaire. *Gaz. d. hôp., Par.*, 1890, lxiii, 349-353.
- TURNER, G. G.: The radical cure of hernia. *Med. Press & Circ., Lond.*, 1915, n. s., xcix, 608-612.
- TURNER, P.: Inguinal hernia; the imperfectly descended testicle and varicocele. *Lond., Churchill*, 1919.
- TURNER, P.: Obstruction by a band in a large scrotal hernia. *Brit. M. J., Lond.*, 1921, i, 738.
- VAUGHAN, G. T.: Some rare forms of hernia. *N. York M. J.*, 1907, lxxxv, 1072-1073.
- VOELCKER, F.: Appendektomie und Radikaloperation einer rechtsseitigen Leistenhernie in einer Sitzung. *Beitr. z. klin. Chir., Tübing.*, 1911, lxxii, 600-603.
- WERELIUS, A.: Andrews' operation for inguinal hernia with report of 316 cases and modification of technic. *Illinois M. J.*, 1921, xxxix, 53-56.
- WHITE, J. M.: Inguinal hernia. *N. York M. J., Chicago*, 1906, lxxxiv, 71-74.
- WHITE, J. N.: An anatomical incision for groin surgery. *Penn. M. J., Athens*, 1919, xxii, 540-542.
- WILKIE, D. P. D.: Observations on inguinal hernia, with special reference to hernia of the bladder and recurrent inguinal hernia. *J. Roy. Nav. M. Serv., Lond.*, 1916, ii, 272-281.
- WINTER, D. T. JR.: Simple operation for double inguinal hernia; one incision; some of its advantages. *J. Med. Soc. N. J., Newark*, 1918, xv, 340-341.
- WÖLFLE, A.: Zur Radikaloperation des freien Leistenbruches. *Beiträge z. Chirurgie Festschrift T. Billroth. Stuttgart, F. Enke*, 1892, p. 552-603.
- WOOD, J.: On rupture. *Lond., J. W. Davies*, 1863.
- WOOLSEY, G.: An operation for the radical cure of inguinal hernia. *N. York M. J.*, 1920, cxii, 21-22.

CHAPTER XIII

INGUINAL HERNIA IN INFANTS AND CHILDREN

Inguinal hernia in infants and children differs from the adolescent and adult types in several ways. At the age of two years the infant becomes a child, and at twelve the child becomes an adolescent.

The Inguinal Canal.—The inguinal canal is comparatively much shorter in children than in adults; in infants it is nearly straight, and the internal and external rings are almost on the same plane. Macready states that the canal at birth is no longer than the thickness of the abdominal wall. (For details on the descent of the testis and patency of the processus vaginalis, and the anatomy of inguinal hernia in infants and children, see chapter on the anatomy of inguinal hernia.)

Frequency of Oblique and Direct Hernia.—Practically all hernias in infants and children are oblique. Direct hernias are very rare. In 4,114 operations on patients under 14 years of age, Coley and Hoguet found 21 direct hernias.

The Bladder.—In the newly born and in infants, the bladder lies high, and Camper believed that this affords a certain amount of protection to the internal rings. In operating on young children, the proximity of the bladder should be considered.

Predisposing Causes in Infants.—Inguinal hernias are most common in premature infants or in those who are underweight, and whose muscles are poorly developed or weakened from disease and unable to withstand the increased intraabdominal pressure of crying, colic, flatulence, bronchitis, whooping cough, etc.

Contents of the Sac.—Small intestine is the sole content of the sac in 90 per cent of the hernias in infants and children; omentum is next in frequency. Other viscera that are sometimes found in the sac are: Cecum, appendix, sigmoid, colon, bladder, ovary, tubes, uterus, and in rare instances, the stomach, liver, kidney, pancreas and ureter may be found. Intrascacular adhesions are rare in children. If any of these organs are in the sac, there may be unusual symptoms referred to the viscera involved.

Symptoms and Diagnosis

The symptoms of reducible inguinal hernia in infants are usually confined to irritability, constipation, and colic. The infant cries more than usual, and is under weight and takes its food badly.

In male infants, palpation of both spermatic cords often shows one to

be the larger. In fat babies under one year, the cord is short, the testicles drawn up, and diagnosis is frequently difficult. After one year, the scrotum is more pendulous, and the cord is longer.

Many of the symptoms in children are similar to those in adults. The child is backward in his studies and cannot participate in active games with other children. I recently saw a boy, 3 years old, who for two weeks previous to the appearance of a small hernia, had had a decided limp with some pain in the affected side.

The hernia is usually small and confined to the inguinal canal or to the upper part of the scrotum. (Fig. 107.) The pillars of the external ring are



Fig. 107.—Right oblique inguinal hernia in a boy aged 5. The sac has passed the external ring and is in the upper part of the scrotum.

often poorly developed and relaxed. For this reason, when the hernia is large and of the scrotal variety, it frequently strangulates.

If the child does not cough, and cannot be induced to cry, if pressure is made over his abdomen with the palm of the examiner's open hand, the hernia will usually descend. If the external ring is dilated and relaxed, the index finger can sometimes be introduced into the inguinal canal and follow the cord up to the internal ring. (Fig. 108.) Because the inguinal canal passes directly backward, it is often impossible to differentiate an oblique hernia from a direct hernia.

In female children it is sometimes difficult to locate the external ring, and the hernia does not descend as readily or as far as in male children. If it is irreducible, it almost always contains the ovary and tube, and in rare

instances, the uterus. As a rule, the diagnosis in both infants and children is simple. Hydrocele of the cord, or of the canal of Nuck, occurs frequently and is to be differentiated from hernia. (See differential diagnosis.)

In infants and children a hernia is sometimes translucent on account of the thinness of the intestinal walls; this fact should be remembered in differentiating hydrocele and hernia. Hess suggested a rectal examination to aid in differentiating strangulated hernia from hydrocele. This method is only applicable to infants and young children in whom the examining finger can reach the os pubis.

Appendicitis and Hernia.—When an infant or child complains of pain in a hernia or undescended testicle, appendicitis should always be suspected. Veau reported 53 cases of appendicitis and hernia operated on in infants and children. He found it very difficult, as a rule, to remove the appendix through the hernial incision in those under 4 years of age. The double operation is ordinarily to be preferred.

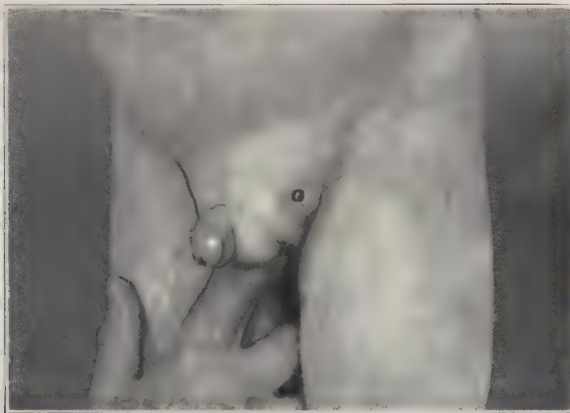


Fig. 108.—Left oblique inguinal hernia in a boy aged 6. The internal ring can often be reached by passing the finger up over the pubis and following the cord. The scar on the scrotum is due to pressure from a spring truss.

Symptoms of Strangulation.—Strangulation may occur any time after birth. In infants the most striking symptoms of strangulation are: Profound collapse, with rapid, thready pulse, and cold damp extremities; vomiting, first of stomach contents, followed by intestinal contents; and violent, continuous and uncontrollable screaming. Ingham reported a child who screamed continuously for thirty-six hours until relieved by operation. There is always constipation and scanty urination, sometimes retention of urine. The symptoms in children, especially the older ones, are similar to those found in adults. Johansson reported the case of an infant three weeks old in whom strangulation of an inguinal hernia took place during a tetanic convulsion.

The Mortality of Untreated Strangulation in Infants.—According to Flament, the mortality of untreated strangulation in infants is 37 per cent

after the first twenty-four hours, 54 per cent after forty-eight hours, and 78 per cent after seventy-two hours.

Spontaneous Cure of Hernia in Infants and Children.—Owing to the fact that patency of the processus vaginalis exists at birth in 50 per cent of infants, hernia is most frequent during the first few months of life. By the end of the first year, spontaneous obliteration of the processus vaginalis has taken place in a majority of infants, when hernia rapidly decreases in frequency. This is one of the strongest arguments in favor of the conservative treatment.

Macready reported 17,538 inguinal hernias occurring in males. Of these 3,158 first appeared during the first year of life; 670 between the first and fifth years, and 390 between the sixth and tenth years. Inguinal hernia is four times more frequent during the first year than in adult life.

Ochsner states that 95 per cent of all hernias in infants and young children will close spontaneously if the intraabdominal pressure is lessened sufficiently to keep the sac empty. This is accomplished by a restricted diet, the prevention of coughing, and by keeping the little patient in bed with the foot of the bed elevated. Sometimes fourteen hours' sleep each night, with the foot of the bed elevated, will keep the sac empty.

Treatment of Inguinal Hernia in Infants and Children

There is much diversity of opinion as to when operation should be undertaken in children. The general surgeons advocate early operation without giving mechanical treatment a trial; on the other hand, those who do considerable pediatric surgery are more conservative.

I am in accord with Coley, Buford, and others in believing that the best rule is not to operate on a simple easily controlled inguinal hernia before the fourth year of age unless truss treatment has been given two years' trial. The results following truss treatment in young children are very favorable. Coley estimated the number of cures at over 50 per cent; De Garmo placed it at 75 per cent, and Ochsner believed it is as high as 95 per cent.

Dangers of Operation in Infants and Young Children.—There is a definite mortality following the radical operation in infants and young children, which, while lower than in adults, is still higher than in children between four and twelve years of age. Gatti stated that the mortality rate was 1.45 per cent under 6 years of age; and 0.71 per cent from 6 to 12 years of age.

The infant is liable to develop pneumonia following the anesthetic and is very susceptible to gastro-intestinal disorders when confined in bed. There is increased danger of wound infection from urine and feces, and when the baby is confined with other sick children, there is considerable danger of such infectious diseases as diphtheria, scarlet fever, measles, erysipelas and whooping cough.

Mechanical Treatment.—A bandage or worsted truss can be applied to an infant under a month old. After this age it can wear a light spring truss covered with muslin or flannel, with a soft cloth placed between the pad and the skin to prevent chafing. The skin must be kept clean, dry and well powdered at all times. If the little patient does not cry at night, the truss may be left off or replaced by a light bandage.

The Truss.—The best truss for infants and children is of the frame type and should be made of phosphor bronze so it will hold the hernia by resistance, and not by pressure on the hernial ring as with the spring truss.

A frame truss can be applied to an infant one day old if necessary. Just as much care should be exercised in fitting a truss to an infant or child as is given to an adult. The truss should be changed frequently as the child grows. The rules for fitting of trusses to adults, apply also to infants and children.

The Worsted Truss.—The worsted truss is sometimes indicated for very young infants when it is impossible to secure a frame truss. It is never to be employed for older children as it does not make enough pressure to hold the hernia, which is always liable to slip by and strangulate.

A worsted truss can be made as follows: Select from eight to twelve strands of a skein of any strong white knitting wool, form a loop and fit to the child's body below the navel. Tighten the loop and place the knot in the external ring. Cut the free end and draw it down along the inside of the thigh and back up across the gluteal fold, and tie it to the loop that passes around the pelvis.

The day of the worsted and spring truss has passed. No physician is justified in applying either of these or an elastic band if a frame truss can be secured. When the proper truss is not available, it is far better to apply a spica bandage even though it causes the little patient considerable annoyance. It is possible that the pressure exercised by a spring truss in infancy is a cause of pelvic dystocia that may persist into adult life.

Treatment of Hydrocele by Truss.—Langton treated hydroceles in children successfully with a truss. He fitted it so the pad pressed directly on the hydrocele; this practice is to be condemned.

Indications for Operations in Infants and Young Children.—Operative treatment is indicated regardless of the age of the patient under any one of the following conditions: When the hernia is strangulated or irreducible, immediate operation is imperative. When the hernia cannot be retained by a properly fitted truss, operation should be resorted to. When the patient cannot wear a truss owing to deformity or disease; when the hernia is complicated by a hydrocele in the inguinal canal; when there is adherent omentum or intestine in the sac; when there are recurrent attacks of strangulation; when the hernia has not reduced in size after two years of truss treatment; when the parents refuse the truss and insist on operation, and when the testicle is in the inguinal canal and only partially descended.

Delayed descent of the testicle may make the fitting of a truss impossible, or the pressure of the pad on the testicle may cause pain and discomfort, as well as atrophy of it and possibly malignant degeneration.

Radical Operation.—Great care must be taken in operating on infants and young children for hernia. The structures are very delicate, and are easily torn by careless or rough dissection and retraction. Only a very short skin incision is required, not over one and a half inches (4 cm.) long, and it should not extend below the external ring on account of the danger of urine infection. In freeing the sac from the tiny vas deferens, the greatest dexterity is required.

The modified Bassini operation is done as described for the adult. On account of the short canal, one or two deep sutures are sufficient in infants, and two or three in older children. The cord can be transplanted without injury if the dissection is carried out very gently.

Some operators are content with a simple ligation of the sac that leaves the cord undisturbed. However, in infants and children, as in adults, there is a higher percentage of recurrences when the cord is not transplanted. It is usually not necessary to overlap the aponeurosis of the external oblique, unless it has been stretched by a large hernia. The subcutaneous tissues and skin are closed without drainage.

The Dressing of the Wound.—A waterproof dressing for the wound is essential for these little patients to prevent contamination by urine and feces. A small gauze dressing is placed over the wound and covered by a piece of gutta percha. Several layers of gauze squares saturated with collodion are successively applied over the gutta percha and extended beyond its edges. The regular gauze or cotton pad dressing is placed over the collodion gauze dressing, and changed whenever it becomes soiled. If the adhesive straps and lower half of the dressings are painted with collodion or compound tincture of benzoin, there will be slight danger of the wound becoming infected from urine.

Mortality and Recurrence in Infants and Children.—Stiles reported 360 infants and children operated on for inguinal hernia, with 5 deaths due to the operation, and 4 recurrences. Salzer reported 352 infants and children operated on for inguinal hernia with 3 deaths. Kovács reported 232 patients operated on for inguinal hernia with one death, due to the operation; of 144 patients traced, there was one recurrence. Pfähler reported 46 patients operated on for inguinal hernia, with no deaths, and one recurrence.

Postoperative Treatment.—Infants are only slightly inconvenienced by operation. They are able to nurse soon afterward, and can be given to the care of their mothers almost immediately. Older children sometimes require a dose or two of paregoric for the pain and restlessness.

The head of the bed is kept elevated, so that when the child urinates there is less danger of contaminating the wound. In male children, I stretch

a piece of gutta percha or rubber sheeting or adhesive plaster over the penis and fasten it on either side to the thighs. A bed arranged so that the covers are held up by a frame and do not touch the child, will prevent the danger of wet covers coming in contact with the wound dressing, soiling and loosening it. Children who can walk alone should be kept in bed one to two weeks.

Reed states that postoperative increased intraabdominal tension, when due to constipation and flatulence, can often be relieved in infants by reducing the amount of protein in the diet and giving more cream.

Treatment of Strangulated Hernia in Infants and Children

1. **Taxis.**—If the strangulated hernia is of only a few hours' duration, an attempt to reduce it by cautious taxis is sometimes justifiable. The child can be placed in a warm mustard bath or hot compresses may be applied to the tumor, which is gently kneaded. If this is unsuccessful, sometimes reduction can be effected by slinging the child up by its feet, with its head downward, and while in this position making taxis on the strangulated mass. Often it is helpful to have the foot of the bed elevated while applying gentle pressure on the tumor; and sometimes flexing the thigh and rotating it outward will aid taxis.

2. **Radical Operation.**—In strangulation of more than a few hours' duration, immediate operation is imperative without preliminary attempts at taxis; in strangulation of very short duration, if taxis is unsuccessful after a few minutes' trial, operation must be done at once without further attempt at taxis.

Shock and chilling of the body must be guarded against by placing an electric pad under the little patient on the operating table, or by surrounding him with hot water bottles. The quickest and simplest operation must be done; usually it is best not to take the extra time required to transplant the cord.

Bibliography

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- BUFORD, C. G.: The dressing and care of herniotomy wounds of infants and small children. *Surg. Gynec. & Obst.*, Chi., 1913, xvii, 632-35.
- CAMPER, P.: *Sämtliche kleinere schriften*. Leipzig, S. L. Crusius, 1785, ii, 50.
- COLEY, W. B., AND HOGUET, J. P.: Operative treatment of hernia. *Ann. Surg.*, Phila., 1918, lxxviii, 255-268.
- DE GARMO, W. B.: *Abdominal hernia*. Philadelphia, Lippincott, 1907.
- FLAMENT, R.: Notes sur la chirurgie d'urgence chez le nourrisson. *Nourrisson*, Par., 1919, vii, 23-31.
- GATTI, G.: *L'ernia inguinale nell'infanzia*. Bologna, L. Cappelli, 1920.
- HESS, R.: Ein einfaches Verfahren zur Unterscheidung der eingeklemmten Hernie von der Hydrocele des Säuglings. *Fortschr. d. med.*, Leipz., 1921, xxxix, 942.
- INGHAM, J. H.: Strangulated hernia in a child three weeks old. *Med. J. Australia*, Sydney, 1917, ii, 227.

- JOHANSSON, S.: On infant surgery. *Acta Chir. Scandinav.*, Stockholm, 1922, liv, 455.
- KOVÁCS, P.: Die operative Behandlung der Kindlichen Leistenbrüche. *Arch. f. klin. Chir.*, Berl., 1909-1910, xci, 177-185.
- LANGTON, J.: See Macready: p. 220.
- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- OCHSNER, A. J.: Surgical treatment of hernia in children. *St. Paul M. J.*, St. Paul, Minn., 1917, xix, 151-153.
- PFAEHLER, P.: Über die ambulante operative Behandlung der Leisten- und Nabelbrüche im frühen Kindesalter. *Deutsche Ztschr. f. Chir.*, Leipz., 1912, cxvi, 543-573.
- REED, R. J.: Hernia in children. *West Virg. M. J.*, Wheeling, 1911-12, vi, 385-387.
- SALZER, H.: Ueber die operation der Schragen Leistenhernie. *Wien. klin. Wchnschr.*, 1921, xxxiv, 543.
- STILES, H. J.: The operative treatment of hernia in infants and young children. *Brit. M. J.*, Lond., 1904, ii, 812-817.
- VEAU, V.: Hernies et appendicite chez l'enfant. Ectopie testiculaire et appendicite. *Bull. méd., Par.*, 1917, xxviii, 492.

CHAPTER XIV

FEMORAL HERNIA

Synonyms.—Crural hernia; Pectineal hernia; Cloquet's hernia; Merocele; Bécclard's hernia.

Definition.—A femoral hernia is a protrusion of abdominal or pelvic viscera through the femoral ring into the femoral canal or beyond it.

Femoral hernia is much more frequent in women than in men. According to Berger, femoral hernia constitutes 32.7 per cent of all hernias in women, and 5.6 per cent of those in men. It is less common than inguinal hernia in both sexes.

Historical

Femoral hernia was believed to be a variety of inguinal hernia until 1572, when Guy de Chauliac pointed out its differences. In 1665 N. LeQuin wrote that it was more difficult to treat than inguinal hernia. Verheyen, in 1699, and Barbette, in 1672, observed that these hernias accompanied the femoral vessels.

Early descriptions of femoral hernia were published by Mauchart, in 1722; Arnaud, in 1748; and de Garengeot, in 1748. These surgeons thought that the sac was situated in front of the femoral vessels, although Bassuel, in 1734, had observed that it was located in the angle between the femoral arch and the pubis.

De Gimbernati, in 1768, demonstrated the ligament that bears his name, and in 1777 he used his method of dividing the constriction in strangulation, for the first time, on a living subject. He pointed out that by dividing the constriction (Gimbernati's ligament), the danger of hemorrhage was less than by the old custom of cutting the ring directly upward, a practice which was often followed by fatal hemorrhage. In 1793 he published the first accurate description of the anatomy of femoral hernia.

Cooper, in 1804, made a further study of this subject and described the ligament that bears his name.

Anatomy

The muscles and fasciae of the femoral region are fully described in any textbook on anatomy, and it is unnecessary to consider them here.

The Femoral Canal.—The femoral canal is the narrow space between the femoral vein and the inner wall of the femoral sheath. It is about $\frac{1}{4}$ to $\frac{1}{2}$

inches (0.6 to 1.25 cm.) long, and transmits the lymphatics from the thigh to the abdomen. The femoral canal is difficult to demonstrate unless the femoral sheath has been separated from the vein by the pressure of a hernia or tumor. (Fig. 109.)

The Femoral or Crural Ring.—The femoral ring is the internal opening of the femoral canal and it communicates with the abdomen. The ring is oval in form, and its width is greater than its length. It varies in size, being larger in females because Gimbernat's ligament is narrower, weaker, and less securely attached in females than in males. In men the ring is $\frac{1}{2}$ to $\frac{3}{4}$ of an inch (1.25 to 1.85 cm.) wide, while in women it is $\frac{3}{4}$ to 1 inch (1.85 to 2.5 cm.) wide.

Boundaries of the Ring.—The femoral ring is bounded on the inner side by Gimbernat's ligament. This ligament is poorly developed in children

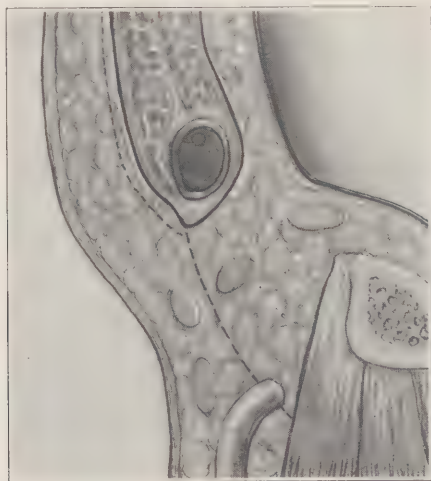


Fig. 109.—A cross-section of the femoral region.

and often lies in contact with the femoral vein. The inner boundary also has some fibers from the iliac portion of the fascia lata and from the deep femoral arch. Gimbernat's ligament is strengthened by Colles' ligament and the conjoined tendon. The femoral ring is bounded on the outer side by the femoral vein; in front by Poupart's ligament and the deep femoral arch; and behind by the horizontal ramus of the pubis which is covered by the origin of the pectineus muscle and fascia.

The Femoral Fossa.—The femoral fossa is a depression in the peritoneum on the inner surface of the abdomen below Poupart's ligament at a point corresponding to the position of the femoral ring.

The Points of Exit of Femoral Hernia.—Femoral hernia usually descends between the femoral vein and Gimbernat's ligament. Velpeau termed this

hernia *hernie crurale moyenne*. Femoral hernia may also descend above the femoral vessels and slightly external to them.

Hernia beneath Poupart's ligament external to the femoral vessels is very rare, because of the firm attachments of the iliac and transversalis fasciae to the outer half of Poupart's ligament, and also because of the resistance offered by the psoas and iliacus muscles and the iliac fascia. The inner angle of the iliopubic space is equally resistant to the exit of hernia as it is protected by Poupart's ligament, Gimbernat's ligament, and the pectineus muscle and fascia.

The Femoral Vessels.—The femoral vessels lie in the lacuna vasorum, between the inner and outer angles of the iliopubic space. The vessels do not occupy all of this space; if they did, there would be danger of constriction when the thigh is flexed on the abdomen.

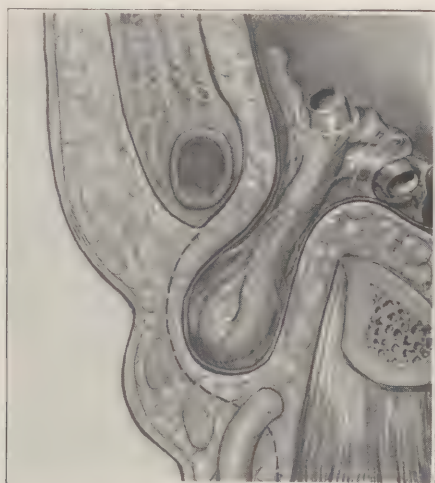


Fig. 110.—The hernia has separated the femoral sheath and vein. The hernia descends directly downward after it passes the femoral ring.

The fascial sheath that accompanies the femoral vessels is derived from the iliac and transversalis fasciae. It is loosely adherent at the femoral ring, and as it passes downward it becomes closely united to the vessels $\frac{1}{2}$ to $\frac{3}{4}$ of an inch (1.25 to 1.85 cm.) below the femoral ring; at this point it is known as the saphenous or external opening.

Contents of the Femoral Canal.—The femoral canal contains a small amount of fatty tissue and a few lymph vessels. The septum crurale of Cloquet closes the femoral ring and acts as a barrier against the descent of hernia. The size of the femoral canal varies with the position of the limb; it is smallest when the thigh is abducted or everted and largest when the thigh is flexed on the pelvis, adducted, and rotated inward. A large lymph gland can often be palpated near the saphenous opening. This gland is known as Cloquet's ganglion or Rosenmüller's gland.

Descent of Femoral Hernia.—A femoral hernia at first descends almost perpendicularly because the transverse axis of the femoral ring, which is parallel with Gimbernat's ligament, is nearly horizontal when the subject is in the erect position. (Fig. 110.)

When the hernia in its descent reaches the saphenous opening it is only temporarily arrested by the fascia, and beyond this point there is nothing to prevent its rapid enlargement in the soft yielding tissues of the thigh.

Coverings of Femoral Hernia.—The coverings of a femoral hernia from within outward are: (1) Extraperitoneal tissue; (2) the septum crurale; (3) the femoral sheath (transversalis fascia); (4) the cribriform fascia; (5) the superficial fascia, and (6) the skin.

Cooper's Ligament.—In 1804 Cooper described the ligament that bears his name, and called it the "pubic" ligament. It is a strong ligamentous band extending from the tuberosity of the pubis outward above the iliopectineal line and covering the ramus of the pubis. It is composed of thick strong fascia, formed by the fusion of the following fascial layers: The pectineal fascia, Colles' ligament and the transversalis fascia, Gimbernat's ligament, the fascia from the margin of the lower attachment of the linea alba, and Henle's and Hesselbach's ligaments. (Testut, Gray, Poirier and Charpy.)

Lockwood called attention to the strength of Cooper's ligament. He remarked that with a hook beneath the ligament one could lift the pelvis of the cadaver from the table.

The Sac.—The sac of femoral hernia is a protrusion of peritoneum through the femoral ring. It is usually congenital in origin and may contain any of the movable abdominal or pelvic viscera. If the sac is small it is often empty on account of the narrowness of the lumen or the constriction at the femoral ring. The mouth of the sac is the part resting in the femoral ring; the neck of the sac is the part lying in the femoral canal; and the body or fundus is the portion outside of the canal.

A femoral hernial sac is usually small and globular in shape. In large hernias it may assume any shape, and in rare instances it may extend to the knees.

Hour-glass Sac (Hernie en Bissac).—An hour-glass sac may have two or more prolongations or loculi emerging from the femoral ring, either through Gimbernat's ligament, or on the surface of the pectineus muscle, or through the cribriform fascia or beneath it.

Double Sacs.—It is probable that double sacs are formed by reduplication of a peritoneal pouch into an unobliterated congenital diverticulum, or there may be two congenital diverticula passing through the femoral ring. Double femoral hernias are rare, although several cases have been reported in the literature. Scott operated on a woman, aged 37, with two femoral hernias on the right side. He called attention to the danger of wounding the femoral vessels when one hernia is external to them.

Contents of the Sac.—Omentum is found in the sac most often. Small intestine is seldom present, except when strangulated, and the following viscera are sometimes found: Colon, cecum, appendix, sigmoid, bladder; and very rarely, ovary, fallopian tube, uterus, testis, kidney, gall-bladder, and liver. When omentum is in the sac, it is often adherent to the sac wall, to other viscera, or it may be the seat of epiploitis.

Ahrens and Spiegel reported cases of incarceration of the stomach in a femoral hernia sac. Seawell operated on a man, 83 years old, for strangulated left femoral hernia. As long as the patient could remember, a lump had appeared from time to time in the left groin, remained for a few hours and then disappeared. The appearance of the mass was always accompanied by severe pains in the epigastrium. During the last attack the mass was irreducible for five days; it was the size of a hen's egg, somewhat tender, firm to the touch, immovable, and was accompanied by pain and vomiting. At operation the sole content of the sac was a bluish-black mass, which proved to be an undeveloped kidney. This strangulated kidney was excised, without relief of symptoms, and the patient died on the fourth day.

I operated on a femoral omental hernia in a woman 79 years old. It had been irreducible for ten years, and during this time there had been constant pain in the epigastrium and stomach, which was never entirely relieved until the hernia was operated on. Local anesthesia was used and the patient made an uneventful recovery.

Chevrier reported 2 cases in which a loop of the round ligament entered the femoral ring beside the hernial sac. The fallopian tube is a rare content of a femoral hernial sac. Cottu and Kuss reported a case of femoral hernia of a cyst of the round ligament that was the size of a small orange, and caused occasional attacks of severe colicky pain and vomiting.

Relation of the Femoral Vessels to the Hernia.—In the common variety of femoral hernia, the femoral vein is to the outer side of the hernia and the internal saphenous vein is in front of the hernia and also to the outer side.

Frequency on the Right and Left Sides.—Femoral hernia is more frequent on the right side in both sexes. Inguinal hernia occurs with nearly equal frequency on both sides in women, while femoral hernia is nearly twice as frequent on the right side in women. Kotzareff reported 65 cases in women; of these 46 were on the right side (32 strangulated) and 19 on the left side (9 strangulated).

Frequency of Femoral and Inguinal Hernia in Men.—In 8,655 cases of inguinal and femoral hernia in Italian soldiers reported by Perassi, 8,563 were inguinal and 92 femoral.

Femoral Hernia Associated with Other Varieties.—Femoral hernia may be combined with one or more hernias in other regions. It is most frequently associated with inguinal hernia. In 10,000 cases of hernia, Berger found femoral and inguinal combined in 222 cases; of these 203 were in males, and

19 in females. In 87 cases there were double inguinal and double femoral hernias.

Umbilical hernia is often associated with femoral hernia alone, or combined also with inguinal hernia. Other varieties of hernia are associated with femoral hernia in isolated cases. (Fig. 111.)

In combined or multiple hernia there is almost always a general relaxation of the abdominal wall, and strangulation is less frequent than when the femoral hernia is alone.

Properitoneal Femoral Hernia.—Properitoneal femoral hernia is very rare. LeClere collected 5 cases from the literature and reported a case of his own. The patient was a woman, aged 60; the hernia had a bilocular sac.



Fig. 111.—Umbilical and femoral hernia in a man aged 57. The umbilical hernia had been present for several years. The femoral hernia was of one month's duration and appeared after lifting a heavy object.

Cruro-Scrotal Hernia.—In rare instances inguinal hernia descends into the femoral region instead of into the scrotum. Sometimes it follows an ectopic testis which has descended into the crural region. (See cruro-scrotal hernia in chapter on inguinal hernia.) Giusti reported a case of inguinal and femoral hernia with a single sac.

Eccles reported a case of cruro-serotal hernia in a man, aged 53, in which a right inguinal hernia descended along the thigh to a point three inches (7.5 cm.) above the patella.

The Constricting Point in Strangulation.—In strangulated femoral hernia the point of constriction is almost always the sharp unyielding edge of Gimbernat's ligament; rarely it may be in the meshes of the cribriform fascia at the margin of the saphenous opening, or in the neck of the sac.

Blakeway believed, contrary to the usual teaching, that the chief cause

of strangulation is the narrowness of the neck of the sac, and not the free edge of Gimbernat's ligament. He believed that there is usually a localized thickening of scar tissue at the neck, that is absent in the rest of the sac. I have seen a strangulated femoral hernia which was due to an intraabdominal volvulus.

Previous to the advent of the open operation for strangulated femoral hernia, the obturator artery was usually wounded by blind division of the constriction if its course chanced to be abnormal and it passed close to the free edge of Gimbernat's ligament. Because of the usual fatal outcome, this anomalous course of the obturator artery was termed the *corona mortis*, or "crown of death."

Rare Varieties of Femoral Hernia

1. **External Femoral Hernia (Hesselbach's Hernia).**—External femoral hernia passes into the thigh below Poupart's ligament external to the deep epigastric artery, and is almost always associated with an inguinal hernia of the same side. External femoral hernia sometimes enters the femoral ring outside of the external iliac artery and spreads out in Scarpa's triangle in front of the femoral vessels. This variety of femoral hernia has been studied by Arnaud, Demeaux, Velpeau, Berger, Hesselbach, Bähr, Narath, and others. In the case observed by Demeaux, there were two sacs, one internal to the deep epigastric artery, and the other external to it.

2. **Hernia Through Gimbernat's Ligament (Hernie de Laugier; Hernie Crurale Interne—Velpeau).**—Hernia through Gimbernat's ligament was described by Laugier, in 1833. In this hernia the sac emerges between the fibers of Gimbernat's ligament. The hernia is usually small and lies more internal than the ordinary variety. In rare instances it has bilocular sacs, one loculus coming through the femoral ring, and the other between the fibers of Gimbernat's ligament. In 1858 LeGendre collected from the literature 6 cases of this variety of hernia. A number of cases have been reported in the literature since the radical operation has come into use.

3. **Pectineal Hernia (Cloquet's Hernia).**—Pectineal hernia was first observed by Callisen in 1777, and described in detail by Cloquet, in 1814. Fasano has recently collected 16 cases from the literature.

Pectineal hernia enters the femoral canal, perforates the aponeurosis of the pectineus muscle and remains between this muscle and its aponeurosis, simulating an obturator hernia. Pectineal hernia is probably due to an abnormal insertion of the pectineal fascia. (Fig. 112.)

4. **Retrovascular Hernia.**—The sac of retrovascular hernia follows the femoral sheath downward. Serafini reported a very rare case in which the hernia descended behind the femoral vessels, inside the sheath of the femoral vein. Diagnosis was confirmed at autopsy.

5. **Prevascular Hernia.**—In prevascular hernia the sac is situated in the femoral sheath but in front of the vessels; I believe this variety of hernia

is more frequent than is generally supposed. Narath reported 6 cases of traumatic prevascular hernia following reduction of congenital dislocation of the hip; Moscheowitz has written extensively on this subject, and Cevario has considered this variety of femoral hernia in detail. A number of cases are reported in the literature.

Multilocular Sacs (Cooper's Hernia).—After the sac emerges at the femoral ring, it may divide into loculi that pass in one of the following directions: Through the femoral canal, toward the obturator foramen, and in

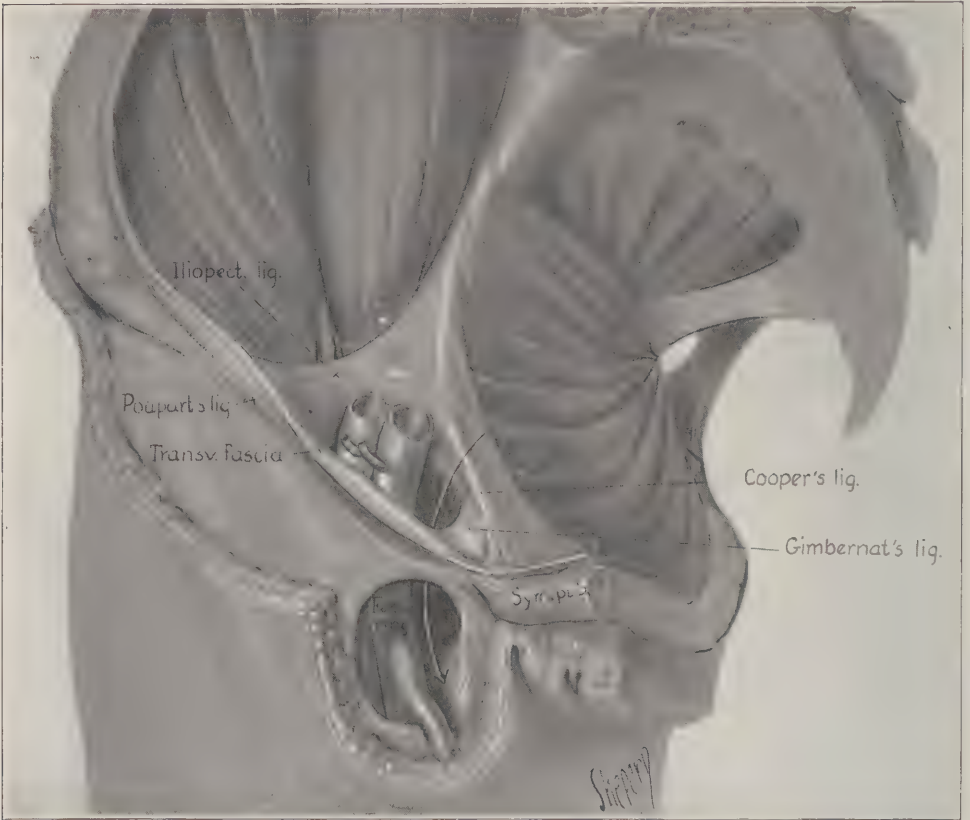


Fig. 112.—The anatomy of femoral hernia. Showing the course of the hernia and its relation to the vessels, and to Cooper's and Gimbernat's ligaments.

rare instances, a third loculus, which is properitoneal, may pass into the labium majus or the upper part of the scrotum. I recently observed a femoral hernia, in a woman, in which one loculus passed into Scarpa's triangle and the second one passed upward onto the external oblique aponeurosis.

Etiology

The Saccular or Congenital Theory.—The congenital origin of femoral hernia is generally accepted today. The hernia enters a preformed pouch or

diverticulum which has failed to become obliterated. In 200 consecutive postmortem examinations reported by Murray, peritoneal femoral diverticula were found in 52 subjects; in 14 of these, the sac was bilateral. Femoral diverticula were found more frequently than inguinal diverticula; in the 200 subjects potential inguinal sacs were found in 13 cases, and in 4 of these the sac was bilateral. Keith found femoral diverticula more frequently in adult subjects than Murray did.

Frequency of Femoral Hernia on the Right and Left Sides.—Femoral hernia is usually single and appears most often on the right side. When it is bilateral, the hernia on the right side is usually the larger.

Age of Onset.—Femoral hernia rarely occurs before the twentieth year. It is more frequent in women, becoming more common as age advances.

Infants and Children.—Femoral hernias are rare in infants and children. They usually occur between the tenth and twelfth years, and are generally single, very seldom double. They ordinarily develop gradually and are not recognized at first. Sex has little influence. Ribera y Sans reported 764 hernias in 6,777 infants examined. Only six hernias were femoral, 3 in males and 3 in females.

Anatomic Causes.—The anatomic conditions that predispose to the development of femoral hernia are: A preformed sac; prominence of the peritoneal depression due to lack of fat; absence of the lymph gland of Rosenmüller; and a large saphenous opening, or a large compressible femoral vein. Joessel believed an open femoral ring is an important factor.

Other predisposing causes are: Pregnancy, parturition, emaciation, increased intraabdominal tension due to obesity or tumors, and relaxation of the femoral ring in the aged.

It is generally believed that occupations requiring a continuous stooping position are a predisposing factor. When femoral hernia occurs in men, it is usually in bakers, stokers or gardeners.

Femoral Hernia Developing after the Operation for Inguinal Hernia.—Femoral hernia occasionally appears after an operation for inguinal hernia. It is probable that the increased intraabdominal pressure following the operation forces the omentum or intestine into a preformed femoral sac. Femoral hernia as well as any other variety of hernia, may develop after any abdominal operation.

Inguinal hernia sometimes occurs after an operation for femoral hernia. The inguinal hernia is usually oblique when the femoral hernia has been operated on by the femoral route; and direct, when the femoral hernia has been operated on by the inguinal route.

When femoral hernia follows an operation for inguinal hernia, it is probably due to the pulling upward of Poupart's ligament by the deep sutures of the inguinal hernia operation which increases the size of the femoral opening. In operating for inguinal hernia it is sometimes advisable to stitch the

conjoined tendon to Cooper's ligament when Poupart's ligament is lax or deficient, to prevent the secondary development of femoral hernia.

Femoral Hernia and Pregnancy.—As pointed out by Cooper, reducible femoral hernia usually disappears in the latter half of pregnancy, and does not recur until after parturition.

Femoral Hernia and Tuberculosis.—The association of femoral hernia and tuberculosis is fairly frequent. The resistance of the tuberculous patient is seriously impaired by the symptoms of femoral hernia, such as colic, nausea, digestive disturbances and partial or complete strangulation. Marked improvement in pulmonary tuberculosis has often followed the cure of the hernia by operation.

Symptoms and Diagnosis

Femoral hernias are usually small and seldom contain intestine, and for this reason the symptoms are less marked than in inguinal hernias. Small femoral hernias are liable to be overlooked in obese subjects.



A.

B.

Fig. 113A.—Femoral hernia of three years' duration in a man aged 30. The hernia will remain reduced with the patient in the standing position. Also left inguinal hernia.

Fig. 113B.—The hernia appears after a strain or cough.

Functional Symptoms.—The functional symptoms are not pronounced unless the hernia is large or contains abdominal viscera. Adherent omentum may cause a dragging pain referred to the lower abdomen. If intestine is in the sac the pain may be colicky, with symptoms of obstruction. Strangulation is frequent and may be partial or complete, accompanied by very severe pain.

As early as 1721, Koch described a numbness or sense of weight in the thigh as a symptom of femoral hernia. Sometimes there is edema of the extremity, due to compression of the vein by the hernia. These symptoms are not always present and are easily overlooked. Pain radiating down the thigh is more often associated with obturator hernia than with femoral hernia. If

femoral hernia contains intestine, a gurgling sound may be heard on reduction. Other symptoms may be referred to the viscera in the sac. Irreducible femoral hernia containing the ovary and tube, especially in infants and children, has often been diagnosed and operated on as strangulated femoral enterocele.

Objective Signs.—Femoral hernia nearly always appears as a small globular tumor, just below Poupart's ligament. It is usually smaller than a hen's egg, although sometimes it may attain the size of an adult's head, and extend down the thigh as far as the knee or below it. On account of the small size of the ring, femoral hernia usually reduces very slowly. (Fig. 113.)

Complications

Strangulation.—Strangulation is 8 to 10 times more common in femoral hernia than in inguinal hernia. Partial strangulation or Richter's hernia in which only part of the lumen of the intestine is nipped by the femoral ring, occurs more often in femoral hernia than in any other variety.

Because the obstruction is incomplete, the symptoms are sometimes indefinite and misleading, but usually one or more of the following symptoms will be present: Nausea, vomiting, colicky pains often associated with tympanites, and profound shock. In strangulated femoral hernia the tumor is often small. Sometimes the only sign of its existence is a tense tender point and a slight fullness just internal to the femoral vessels. In certain cases the diagnosis is made during the operation for supposed intestinal obstruction. On account of the unyielding, constricting wall, gangrene occurs early in strangulated femoral hernia.

Displaced Strangulated Hernia.—Displacement of a strangulated femoral hernia from its usual position in the upper part of Scarpa's triangle, is nearly always due to forcible taxis. The hernia may be displaced by reducing it *en masse* through the femoral ring, or by forcing it through a rent in the femoral sheath into the connective tissues of the thigh. When this accident happens the hernia may appear somewhere below or above Poupart's ligament.

Shiels reported a case in which unsuccessful taxis displaced a strangulated femoral hernia to a position up over the inner third of Poupart's ligament, where it closely resembled a strangulated inguinal hernia.

Bryant observed a case in which taxis had forced a femoral hernia through a rent in the femoral sheath at the inner side of Scarpa's triangle. At operation the site of strangulation was found in the tear in the femoral sheath.

Femoral Hernia Accompanied by Appendicitis in the Hernial Sac.—Sometimes the appendix is found in a femoral hernial sac. A number of cases have been reported in the literature in which operation was undertaken for strangulated hernia, and when the sac was opened only a gangrenous appendix was found. The symptoms of this complication are often misleading. In

a case observed by Doolin, there was a small, tender, painful swelling in the upper and inner angle of Scarpa's triangle; there was no tenderness or rigidity above Poupart's ligament. The femoral sac was distended with pus and contained only a gangrenous appendix.

Differential Diagnosis

Reducible Femoral Hernia.—The conditions most frequently mistaken for reducible femoral hernia are: Incomplete reducible inguinal hernia, saphenous varix, and psoas abscess.

Incomplete Reducible Inguinal Hernia.—An incomplete inguinal hernia is sometimes mistaken for a femoral hernia that passes upward toward Poupart's ligament. If a line corresponding to Poupart's ligament is drawn from the spine of the pubis to the anterior superior spine of the ilium, the

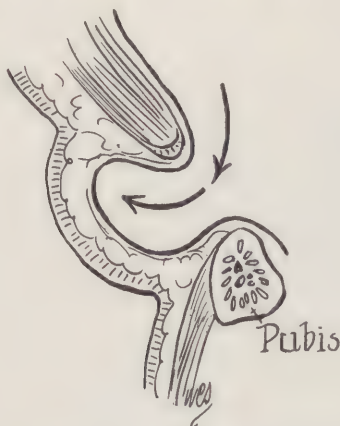


Fig. 114.—Schematic drawing. After the hernia reaches the femoral region it often passes upward on to the aponeurosis, thus simulating an inguinal hernia.

inguinal hernia will lie above this line, while the femoral hernia will be below it.

The inguinal hernia can be reduced by making pressure upward, outward and backward, and pressure over the inguinal canal will prevent its descent. Femoral hernia is reduced by pressure backward and upward, and returns to the abdominal cavity very slowly.

In direct inguinal hernia the direction of reduction is backward and upward, and reduction is much quicker than with femoral hernia. Inguinal hernia can ordinarily be reduced with the patient in the erect position, while with femoral hernia it is usually necessary for the patient to lie down.

In differentiating reducible inguinal hernia from reducible femoral hernia, the three important landmarks are the pubis, femoral artery, and the spermatic cord. Cases are on record in which an operation has been done for inguinal hernia, and the mistake in diagnosis discovered only after the patient was

out of bed. When the diagnosis between inguinal and femoral hernia is difficult or impossible, the hernia is usually femoral. (Fig. 114.)

Saphenous Varix.—The differentiation of saphenous varix from inguinal and femoral hernia was first described by Boinet in 1836. A saphenous varix disappears when the patient lies down, no pressure being required to reduce it, and its reappearance when the patient stands up can be prevented by making pressure over the femoral canal. There is no gurgling on reduction and a humming murmur is heard on auscultation. A characteristic thrill is felt over the varix when the patient coughs. The only other condition that resembles saphenous varix is hernia associated with ascites. The symptoms of dilatation of the upper portion of the saphenous vein are the same as those of saphenous varix. The skin over the saphenous varix is bluish if there is



Fig. 115.—Lipoma in the femoral region in a man aged 38. This condition is sometimes mistaken for irreducible femoral hernia.

no subcutaneous fat; if the fatty tissue is abundant, no difference in color can be detected. The varix is usually about one-half inch (1.25 cm.) below the saphenous opening. In 10 cases of saphenous varix collected from the literature by Richardson, 7 were diagnosed before operation as strangulated or incarcerated femoral hernia. Saphenous varix should be treated by ligating the vein above and below the varicosity, and the dilated portion excised.

Varicose Veins.—Varicose veins in the labium majus may be present during pregnancy, and are not to be confused with femoral hernia.

Psoas Abscess.—When psoas abscess descends into the thigh, it usually appears as a symmetrical fluctuating mass which transmits an impulse on coughing, and is reducible without a gurgling sound. A tumor can be felt

above Poupart's ligament. The spine should be examined for tuberculosis, which will almost always be found, and is the source of the abscess.

Obturator Hernia.—Obturator hernia may rarely be mistaken for femoral hernia. Examination of the femoral canal will show that it is empty. (The symptoms of obturator hernia are described elsewhere.)

Irreducible Femoral Hernia.—The conditions most frequently mistaken for irreducible femoral hernia are femoral adenitis and lipoma.

Femoral Adenitis.—Adenitis in the femoral region gives no impulse on coughing, and usually several enlarged glands can be felt. Sometimes a small strangulated femoral hernia is mistaken for a broken down lymph gland, especially after the intestine has perforated and the sac is tender, painful and fluctuating. Occasionally, a femoral adenitis overlies a strangulated hernia. Ross reported a case in which he incised the suppurating lymph glands and found beneath them a small mass, which proved to be a strangulated femoral hernia.

Femoral Lipoma.—A lipoma in the femoral region gives no impulse on coughing. It usually lies external to the saphenous opening, and below it, and the femoral canal is empty. A lipoma can be lifted up with the skin to which it is adherent. When it is situated in front of a femoral hernia, it must not be mistaken for adherent omentum in the sac. Strangulated lipoma closely resembles a strangulated hernia. As a rule, the hernia is less movable than the lipoma. (Fig. 115.)

Other Conditions to be Differentiated.—Other conditions that may be mistaken for femoral hernia are: Cysts, fibromas, new growths in the femoral region, distended psoas bursae, hydatid cyst, muscle hernia of adductor longus, strangulated obturator hernia lying behind a reducible femoral hernia, and aneurysm of the femoral artery. In the last-named condition, there is an impulse over the tumor synchronous with the radial pulse.

A lymphocele in the femoral region may simulate an irreducible hernia. If small, it may be mistaken on palpation for a lipoma. In the tropics filarial lymphoceles are not uncommon.

Prognosis

The prognosis of untreated femoral hernia is grave. Strangulation is 8 to 10 times more frequent in femoral hernia than in inguinal hernia. Truss treatment is dangerous as there is no prospect of a cure by this means, and usually a truss cannot be fitted to femoral hernia so as to retain it safely. If the hernia slips by the truss pad, there is great danger of strangulation. The cause of the high percentage of strangulation in femoral hernia is due to the sharp unyielding edge of Gimbernat's ligament, which forms the inner boundary of the small femoral ring, and the direction of descent of the hernia, which is downward, forward and upward.

The radical operation is the only treatment to be recommended for femoral

hernia. In the nonstrangulated variety, the operation is followed by a high percentage of cures. In strangulated femoral hernia the mortality rate is higher than in strangulated inguinal hernia, because gangrene occurs earlier in femoral hernia, and the patient comes to operation later, on account of the difficulties of diagnosis.

Treatment

The radical operation is the treatment of choice for strangulated and non-strangulated femoral hernia. Mechanical treatment is unsatisfactory, dangerous, offers no prospect of a cure, and is to be employed only when operation is refused or contraindicated.

Mechanical Treatment.—Small reducible femoral hernias offer the best prospect of being held by a truss. The method of measuring for a truss is the same as described for inguinal hernia. In the femoral truss, the frame from the shoulder to the pad is more oblique than in the inguinal truss, and the pad is smaller. A water-pad is the most comfortable. The cross-body type of frame truss is one of the most satisfactory. (Fig. 116.) The elastic truss



Fig. 116.—Cross-body frame truss for femoral hernia (Pomeroy).

should never be used, because it permits the hernia to increase in size, and it does not make firm uniform pressure, as a frame truss does, consequently the hernia is liable to slip by and strangulate. (See mechanical treatment of inguinal hernia.)

Even when a truss that will control the hernia can be fitted, it is easily displaced because the point on which it presses does not remain fixed. The movements of the muscles of the upper anterior portion of the thigh, in any form of exercise, tend to displace the truss upward. The truss treatment for femoral hernia causes the patient more inconvenience and discomfort than the truss treatment for inguinal hernia. For these reasons, the operative treatment is always to be recommended. The prospect for a cure is excellent, and the percentage of recurrence is even lower than in the inguinal variety. Irreducible femoral hernia almost always consists of omentum and should be treated by radical operation. In strangulated femoral hernia, immediate operation is imperative because of the early onset of gangrene.

The ideal operation removes the sac, closes the femoral opening firmly, and still does not weaken the inguinal canal or rings. The operative treatment of femoral hernia is closely associated with the development of the inguinal hernia operation, and practically all of the operations for inguinal hernia have been used at one time or another for the cure of femoral hernia.

Methods That do not Remove the Sac.—Macewen and Bishop twisted the sac and pushed it up behind the femoral ring; Ferguson also advocated this disposition of the sac. Kocher separated it, twisted it, and brought it out through an opening in Poupart's ligament; then he sutured Poupart's ligament to the pectineus muscle and fascia and to Cooper's ligament.

Baldwin drew the sac up through an opening in the aponeurosis of the external oblique and obliterated it by a continuous through-and-through stitch. One end of the suture is passed into the femoral canal and a bite taken in the pectineus muscle and fascia, and the suture passed back through the femoral ring. When the ends of the stitch are tied, the femoral canal is closed and the puckered sac displaced downward, behind the aponeurosis of the external oblique.

Billroth incised the sac but did not remove it, and partly closed the femoral ring by a simple suture.

Dowden used the combined femoral and inguinal incisions. A pad consisting of the folded sac, augmented by a ball of fat from the omentum or from the thigh, is sutured inside the femoral ring.

Methods That Remove the Sac.—

1. *Without Closure of the Canal.*—Socin, in 1879, dissected the sac as high as possible, ligated and excised it, and made no attempt to close the opening. He reported 6 patients cured by this operation. A similar method has been used by Ochsner since 1892; Banks was also content to ligate the sac without closing the ring. LaRoque exposed the sac through an abdominal incision just above the internal ring, inverted and excised the sac, and sutured the peritoneal edges to the original peritoneal incision. The femoral opening was not disturbed, and the abdominal incision was closed in the usual manner.

2. *Suture of the Femoral Ring.*—There are several methods of closing the femoral ring by sewing Poupart's ligament to Cooper's ligament:

A. *With a Pursestring or Mattress U-Suture.*—Marey and Tricomi isolated and resected the sac and passed a pursestring suture, which included Poupart's ligament, the sheath of the femoral vessels, the pectineus muscle and fascia and Gimbernat's ligament, and emerged through Poupart's ligament near the original point of entrance. A similar method was described by Wood, Bottini, and also recommended by Coley. Cushing employed two pursestring sutures: The first approximated Poupart's ligament to the pectineal fascia and closed the femoral canal, and the second closed the saphenous opening.

Berger passed a mattress or U-suture through Poupart's ligament into the femoral canal, and after taking a bite in the pectineus muscle and fascia, the stitch is passed through Poupart's ligament and when tied, it approximates the pectineal fascia to Poupart's ligament. Kummer passed a mattress or U-suture from a point about 1 inch (2.5 cm.) above the lower edge of Poupart's ligament, through the aponeurosis of the external oblique, the

internal oblique and transversalis muscles, then took a good bite in Cooper's ligament, including the periosteum. The suture is passed back through the transversalis, internal oblique and aponeurosis of the external oblique and tied. This draws the abdominal wall down to the femoral ring without stretching or weakening the inguinal canal.

B. Closure by Interrupted Sutures.—Lucas-Championnière resected the sac high up and sutured the sheath of the femoral vessels to the pectineal fascia and adductor longus muscle. Bassini excised the sac as high as possible and passed two or three interrupted sutures from Poupart's ligament to the pectineal fascia. Before he tied these, he passed three to five sutures from the falciform ligament to the pectineal fascia. De Garmo used a single layer of three or four sutures to unite Poupart's ligament to the pectineal muscle and fascia. Simple suture of the femoral ring was practiced by Billroth, Bottini, Frey, and other early operators.

C. Closure of the Canal with Displacement of the Stump of the Sac.—Barker, Berger, Parry, and others displaced the stump of the sac upward under the femoral arch, in a manner similar to that described under inguinal hernia.

D. Closure of the Canal with Division of Poupart's Ligament.—Division of Poupart's ligament was advised by Cooper in 1804, in dealing with certain large strangulated femoral hernias. Fabricius advocated dividing Poupart's ligament at its inner extremity, and suturing it to the horizontal side of the pubis with five or six stitches that pass through Poupart's ligament, the pectineus muscle and fascia and the periosteum. Delagénère divided Poupart's ligament and resected the sac high up, then sutured Poupart's ligament to the pectineus muscle and fascia. Recurrence was very frequent after this operation.

E. Closure of the Femoral Canal by Suturing Poupart's Ligament to the Pubic Bone.—Roux cut off the sac high up and drove a metal staple through Poupart's ligament and into the pubic bone. Nicoll bisected the sac, passed one-half of it through an incision near the base of the other half and then pushed the entire sac up through the femoral ring. Catgut sutures are passed through two drilled holes in the pubis and then through Poupart's ligament, and tightened and tied. A second line of sutures unites the pectineus muscle and fascia to Poupart's ligament. (A similar operation was described by Hammesfahr.) Cavazzani drilled holes in the bone above the obturator foramen and sutured Poupart's ligament to this point.

F. Methods That Close the Canal by Muscle Transplantation.—Lotheissen resected the sac through an opening in the aponeurosis of the external oblique, and closed the upper end of the femoral canal with interrupted sutures, which united the lower margins of the internal oblique and transversalis muscles to Cooper's ligament. Similar operations have been described by Codivilla, Gordon, Guibé and Proust, and Kammerer.

Battle resected the sac through an opening in the aponeurosis of the external oblique, then sutured the upper margin of the aponeurosis to the pectineal fascia, Gimbernat's and Poupart's ligaments. Finally, the lower margin of the aponeurosis is sutured to the anterior surface of the external oblique above the upper margin which it overlaps.

De Garay used a flap from the sartorius. Pólya plugged the canal with the entire thickness of the sartorius. Salzer attempted to close the femoral opening by a flap of pectineal fascia. Stonham and Cheyne turned up a flap of pectineus muscle and fascia and sutured it to Poupart's ligament; Schwartz, McArdle, and Moullin employed similar methods. Hofmann ligated a section of the internal saphenous vein, split it open, and sutured it to the femoral opening.

G. Methods That Close the Canal by Periosteal and Bone Flaps.—Ferguson turned up a flap of periosteum from the pubis and sutured it with the pectineus muscle and fascia to Poupart's ligament. Herzen freed a flap of periosteum, the width of the femoral canal, from the pubis, then drilled holes in the exposed bone through which sutures were passed into Poupart's ligament, and the latter was drawn down when the sutures were tied. The periosteal flap was drawn up and tacked over the first line of sutures.

Trendelenburg detached a large bony flap from the pubis and turned it up to close the femoral canal. Jaboulay turned up a flap from the inner end of Poupart's ligament, leaving a small portion of the bone attached. Ball twisted the sac and left it in the femoral canal. Borchardt turned up a flap of bone and periosteum to close the femoral ring. Wilms employed a flap of fascia lata to reenforce the suture of the ring, and Siek used a flap of the pectineus muscle and fascia for the same purpose. Guibé and Proust sutured the conjoined tendon to Cooper's ligament and then united the pectineus muscle to Poupart's ligament.

H. Closure of the Canal by Heteroplastic Methods.—Thiriar grafted into the hernial opening a portion of the head of the humerus which he had resected. Chaput employed a graft of costal cartilage or a plate of decalcified bone. Platt plugged the canal with a sterile sponge. Silver wire filigree has been extensively used in femoral hernia, as well as in all other varieties.

Closure of the Femoral Canal by Median Laparotomy Incision.—Lawson Tait, in 1883, stated that all femoral and inguinal hernias in women should be operated on by abdominal section. He employed this method in both strangulated and nonstrangulated hernias. After reducing the hernia by cautious traction, the sac is incised if adhesions are present. The femoral ring is usually not incised, and the opening is closed with interrupted sutures of horsehair.

Lucid and Beckman have described intraabdominal operations for femoral hernia which are carried out through an ordinary laparotomy incision,

and the technic of closing the femoral opening is similar to the operation by the inguinal route described a little later.

Closure of the Femoral Canal by Interposition of the Uterus.—When the femoral opening in women cannot be closed by the ordinary operations, it is sometimes advisable to mobilize the uterus by freeing it from the bladder, displace the uterus to the side of the hernia, and suture it behind the internal femoral opening. This procedure should never be employed when the opening can be closed by simpler methods.

The Modern Operations for Femoral Hernia.—There are two methods of operating for femoral hernia, the femoral and the inguinal. The femoral operation is preferred by a majority of operators because it is more direct, simpler, and the average surgeon can perform it more quickly than the inguinal operation; and the results are just as good, *provided the femoral canal is closed*. The inguinal operation is ideal from an anatomic standpoint and gives admirable results in the hands of skillful surgeons; however, a procedure so intricate is not to be recommended for general use in non-strangulated hernia, as long as equally good results can be obtained by simpler methods. The weakening of the inguinal canal is the most serious objection to the inguinal route; this point is generally overlooked by surgeons, probably because patients have a habit of going to another surgeon or to a truss-fitter when they develop a recurrence.

1. The Femoral Operation.—The skin incision is begun one-half inch (1.25 cm.) above Poupart's ligament and extended downward for a distance of three or four inches (7.5 to 10 cm.) over the femoral canal, parallel to the femoral vessels. In small hernias the center of the incision is usually over the center of the tumor. Often it is a good plan to form a curved flap, with its convexity outward, so that the skin wound will be as far as possible from the external genitalia. If the incision does not extend sufficiently above Poupart's ligament, it will be difficult to expose the fascia lata and cribriform fascia over the upper part of Scarpa's triangle.

The internal (or long) saphenous vein passes upward along the inner side of the thigh and through the saphenous opening in the fascia lata about one and a half inches (3.75 cm.) below Poupart's ligament. Care must be exercised not to wound this vein. The edges of the incision in the skin and subcutaneous tissues are retracted to expose the edge of the falciform process of the fascia lata. If the hernia is reducible, the femoral artery and vein are located and retracted out of the way and the pectineus muscle and fascia exposed. If the hernia is irreducible, it may be impossible to locate any landmark except the femoral artery whose position is shown by its pulsation. A careful dissection will prevent mistaking the relaxed fascia propria, the wall of the femoral sheath, or the subperitoneal fat, for adherent omentum.

Freeing the Sac.—It is sometimes difficult to find the sac when it is deeply situated and covered by a thick layer of fat. The presence of the femoral



Fig. 117.—The sac is freed, drawn down and ligated at the femoral ring. Unless the sac is empty it must always be opened before being ligated.



Fig. 118.—The sac has been ligated and excised and a pursestring suture passed to close the femoral opening.

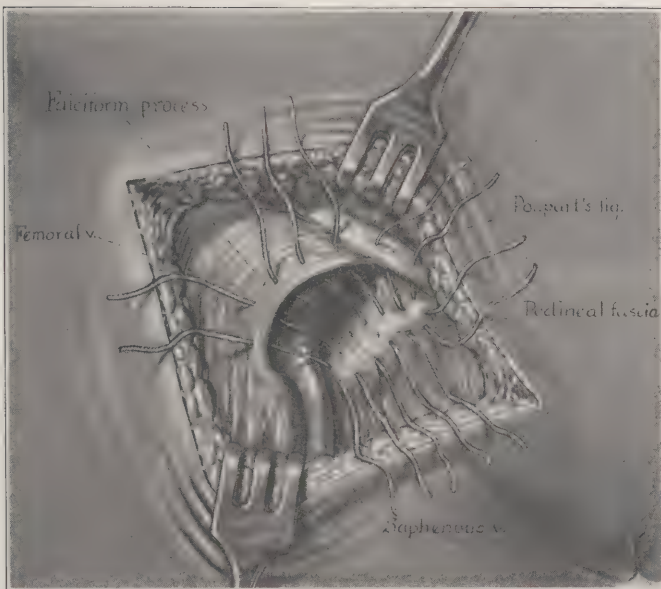


Fig. 119.—Bassini's method of closing the femoral opening by two layers of interrupted sutures.



Fig. 120.—Closure of the femoral opening by one layer of interrupted sutures that approximates Cooper's ligament, the pectineus muscle and fascia to Poupart's ligament.

vessels at the outer side of the neck of the sac must be borne in mind constantly. The sac should be freed by blunt dissection as high as the femoral ring. The sac is usually thin; if it is thick, the possibility of a sliding hernia of the large intestine or the bladder should be thought of.

Opening the Sac.—After the sac is freed, it is opened at a thin clear point, where there are no adhesions of the contents of the sac, and if possible, on the outer side, to keep away from the bladder. Adherent omentum should be freed or divided between ligatures, and the diseased portion excised. The treatment of sliding hernia of the large intestine or bladder is described elsewhere.

Disposition of the Sac.—The sac, freed of its contents, is drawn well down at the femoral ring until the parietal peritoneum which is whiter, denser, and more fibrous than the sac, comes into view. Exposure of the neck of the sac is facilitated by traction on the inner part of the ring—Gimbernat's ligament. The sac is pulled down, transfixed, ligated and excised. Sometimes it can be removed higher if a pursestring suture of the parietal peritoneum is used instead of a ligature. Care must be taken to remove all of the fatty lobules in or near the femoral ring, so that the edges of the ring can be brought together after the sac is removed. (Fig. 117.)

Closure of the Femoral Ring.—If the opening is small or of moderate size, a pursestring suture is all that is needed to close it. This method was first used by Marcy, in 1891, who employed a suture of absorbable tendon. Cushing and Coley popularized the pursestring suture.

The Pursestring Closure.—A full curved round-pointed needle threaded with chromic catgut is passed through the inner portion of Poupart's ligament, close to the femoral vein, including, if possible, some of the fibers of the sheath of the vein. Coming out in the femoral canal, the needle passes inward taking a good bite in the pectineus muscle and fascia, and then through Poupart's ligament from within outward, emerging near the original point of entrance. I have found that one suture is usually sufficient. Tying the suture approximates Poupart's ligament and the pectineal fascia and obliterates the femoral canal. If necessary, a second or third pursestring suture can be passed near the saphenous opening. (Fig. 118.)

Bassini's method consisted of passing three or four interrupted sutures between Poupart's ligament and the pectineal fascia, and two or three additional ones to approximate the falciform process of the fascia lata and the pectineal fascia. De Garmo, Ferguson and others used a simpler method, uniting Poupart's ligament to the pectineus muscle and fascia by three or four interrupted stitches. Marchetti closed the femoral opening with three or four sutures passing through the lower edge of the aponeurosis of the external oblique, the internal oblique, transversalis, and Cooper's ligament, including the periosteum. (Figs. 119 and 120.) Ochsner maintains that it

is unnecessary to suture the femoral canal, excepting when the opening is large and the femoral ring relaxed and widely dilated.

Closure of the Subcutaneous Tissues and Skin.—The subcutaneous tissues are approximated by a running stitch of plain catgut and the skin closed with a continuous subcuticular suture, without drainage.

Andrews' Operation.—When the ring is large and rigid or when it has to be divided to permit reduction of the hernia, Andrews proceeds as follows:

After the sac is removed, the cord or round ligament is raised and held out of the way by an assistant. By gauze dissection Scarpa's triangle is cleared exposing Poupart's ligament from below. A clamp is attached to the lower fragment of the aponeurosis; this clamp is grasped in the operator's left hand, held upward, and the middle finger of this hand inserted into the femoral canal. The needle is then brought from Scarpa's triangle under the ligament, being guided and guarded by the finger so as to avoid the femoral vein, which lies in very close proximity. The needle is pulled through into the canal. A large bite of the conjoined tendon is taken and the stitch is carried back and brought through the sharp edge of Poupart's ligament from within outward. Next, it is carried through the edge of the upper fragment of the aponeurosis and finally out into Scarpa's triangle by going through the lower fragment of the aponeurosis very close to the ligament.

It will be noted that when this stitch is tied it is no longer Y-shaped but circular. The conjoined tendon is pulled under the sharp edge of the ligament and the aponeurosis above it. Two or three sutures are generally sufficient. Large kangaroo tendon should be used. It will be observed that the stitch surrounds Poupart's ligament and that the knots all lie outside of the canal. Finally the cord is replaced, and the lower fragment of the external oblique laid down over it to make a roof for the canal.

The Lateral Rectus Incision for Strangulated Femoral Hernia.—When the femoral incision is employed, and strangulated hernia is found, time can often be saved if the abdomen is opened through a low lateral rectus incision. The intestine is cleansed, freed from adhesions in the sac, reduced into the abdominal cavity, and drawn into the lateral rectus incision, where it is surrounded by hot compresses and dealt with as its condition requires. While waiting to determine the viability of the intestine, the sac in the femoral canal is excised and the ring closed with a pursestring suture.

The advantages of the lateral rectus incision are: Strangulation can be dealt with without extensive division of the femoral ring; resection and anastomosis are more quickly performed through this second incision, because there is no traction on the loops and the operator has more room in which to work; circulation returns more quickly when there is no constriction on it from the ring, and no traction on the mesentery.

Plummer emphasized the fact that when strangulation is dealt with through the femoral incision, the traction on the mesentery is sometimes

sufficient to prevent the return of circulation in the strangulated loop, and for this reason he suggested that before deciding on resection in cases where the viability of the intestine is doubtful, that the intestine be temporarily returned to the abdominal cavity, so that the condition of the circulation can be definitely determined.

Skillern found it necessary to divide Poupart's ligament in treating an incarcerated hernia in a woman. He closed the opening by suturing the free border of the round ligament, with the cremaster muscle and fascia still attached, to the underlying pectineal fascia. The suture line extended from the femoral vein to a point near the pubic bone. The ends of Poupart's ligament were united and the wound closed.

Closure of the Femoral Ring Through the Inguinal Canal.—The inguinal operation for femoral hernia was first employed by Annandale in 1876. While operating on a patient who had an inguinal and femoral hernia on the same side, he discovered that the femoral hernial sac was easily located and the hernia easy to reduce through the inguinal incision. He sutured Poupart's ligament to Cooper's ligament and then closed the inguinal wound. The following year he used the inguinal route as the operation of choice in treating a femoral hernia.

Zuckerkandl, after a series of anatomic dissections, recommended the inguinal operation for strangulated femoral hernia. In 1892 Ruggi described in detail the inguinal operation for femoral hernia, just about as it is used at the present time; in 1893 his monograph on this method appeared. Savini modified the Ruggi operation by using a suprapubic midline incision to obviate the danger of direct inguinal hernia which sometimes develops after operation by the inguinal route. Others who have written important papers on the subject, besides those discussed in the text are: Lotheissen, Codivilla, Förderl, Moschowitz, Bardesen, Bérard, Frank, Vallas and Perrin, Fagge, Reich, Desmarest, Lance, Bevers, Morton, Didier, Seelig and Tuholske, Dujarier, Briggs, Davis, Cole, Landry, Eisendrath, Wernech, and Newbolt.

The Operation.—The operation for femoral hernia by the inguinal route is facilitated if the patient is placed in the Trendelenburg position. This aids in the reduction of the hernia and affords a clear view of the femoral opening.

The Skin Incision.—The incision is made over the inguinal canal about an inch (2.5 cm.) above Poupart's ligament and parallel to it. It is three to five inches (7.5 to 12.5 cm.) long, and similar to the incision for inguinal hernia except that the upper end does not extend so high, and the lower end extends down over the pubic bone into the upper part of the scrotum or the labium majus, in the direction of the femoral ring or hernia.

Incision of the Aponeurosis and Muscles.—The aponeurosis of the external oblique is separated in the direction of its fibers over the inguinal canal. The edges of the aponeurosis are retracted, exposing the conjoined tendon

and transversalis muscle. These muscles are retracted upward along with the spermatic cord or round ligament. Poupart's ligament and the transversalis fascia are exposed when the lower flap of the aponeurosis is retracted downward. The floor of the inguinal canal, which consists of transversalis fascia, is carefully divided parallel to the deep epigastric vessels

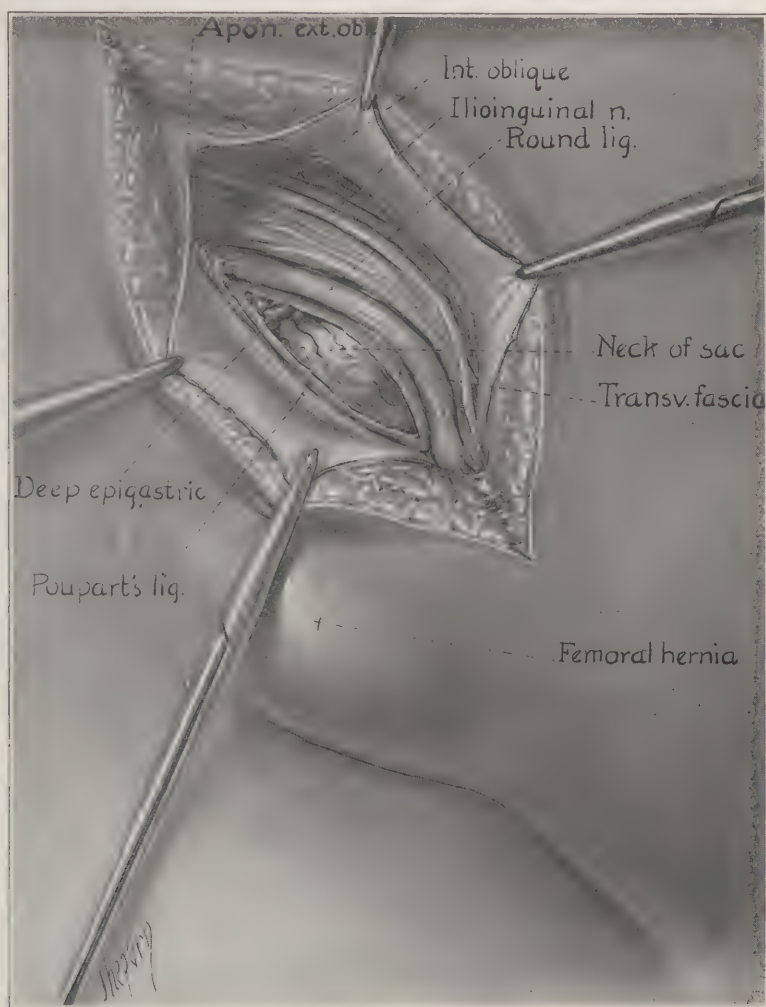


Fig. 121.—Inguinal operation for femoral hernia. Showing the exposure of the neck of the sac and its relation to the surrounding structures.

and to the inner side of them. This incision is directly over the neck of the femoral sac. The deep epigastric vessels are retracted outward. If they are abnormal in their course they may be divided between ligatures; however, they should be preserved whenever possible, as their division may be a predisposing cause of postoperative direct hernia.

With the transversalis fascia incised and the edges retracted, the peritoneum is exposed and opened just above the neck of the sac. (Fig. 121.)

Reducing the Hernia.—In nonstrangulated hernia the contents are reduced by gentle traction. If they are adherent to the wall of the sac, the latter is often inverted as the contents are pulled back into the abdominal cavity. If the contents are not adherent to the sac, it can usually be inverted in the following manner: A long narrow-blade forceps is passed to the bottom of the sac, the fundus grasped, and as the forceps is withdrawn, the sac is inverted.

Supplemental Femoral Incision.—If the sac cannot be reduced through the inguinal wound, it is necessary to prolong the skin incision down over the hernia, retract the skin downward and dissect the sac free of adhesions. If the hernia is irreducible, the sac should be opened by a femoral incision, the adhesions freed, diseased or redundant omentum ligated and excised, and the hernia reduced.

Strangulation.—If there is strangulation, it is dealt with through the inguinal wound as it is much easier to handle it here than through the femoral incision, and if resection and anastomosis are required, they can also be done more expeditiously from the abdominal side.

Inversion of the Sac in Irreducible Hernia.—After the sac has been opened and the contents dealt with, it is inverted into the inguinal wound and treated from above. If the sac is large, I cut away a portion of it to facilitate invagination. After it is inverted the peritoneum is freed for a distance of one-half inch (1.25 cm.) beyond the femoral ring, transfixed by a needle threaded with a catgut suture, ligated and excised. If the femoral opening is large, a pursestring suture of the neck of the sac is often preferable to simple ligation.

Closure of the Femoral Ring.—Two to four chromic catgut or kangaroo tendon sutures are required to close the femoral ring. A small full curved needle threaded with the suture is passed through Cooper's ligament near the sheath of the iliac vein, as the latter is pressed outward by the finger or a small retractor. A good plan is to pass the needle deep enough to include the pericosteum, and even scrape the bone. Next, the suture takes a good bite in the lower flap of transversalis fascia and the edge of Poupart's ligament. This suture is not tied until all are placed. Two or three additional sutures are inserted, depending on the size of the opening; the innermost suture takes a bite in Gimbernat's ligament also. When the sutures are tied, the femoral opening is closed by the approximation of Cooper's ligament to Poupart's ligament. (Fig. 122.)

Cooper's ligament, which is a firm dense white band of fibrous tissue, must always be thoroughly exposed before any suturing is attempted. The pectineal fascia, which forms the posterior margin of the femoral canal, is sometimes mistaken for Cooper's ligament.

Closure of the Muscle and Fascia Incision.—The internal oblique, transversalis muscle, and the upper flap of transversalis fascia are sutured to Poupart's ligament with interrupted chromic catgut or kangaroo tendon.

The Cord.—The cord is usually not transplanted, unless the internal inguinal ring is dilated, or the musculature of the canal is weak; or unless there is more than the usual danger of a direct hernia occurring through the inguinal incision.

The Skin Closure.—The subcutaneous tissues and skin are closed in the usual manner without drainage.

Parlavechio exposed the sac through an incision parallel with the in-

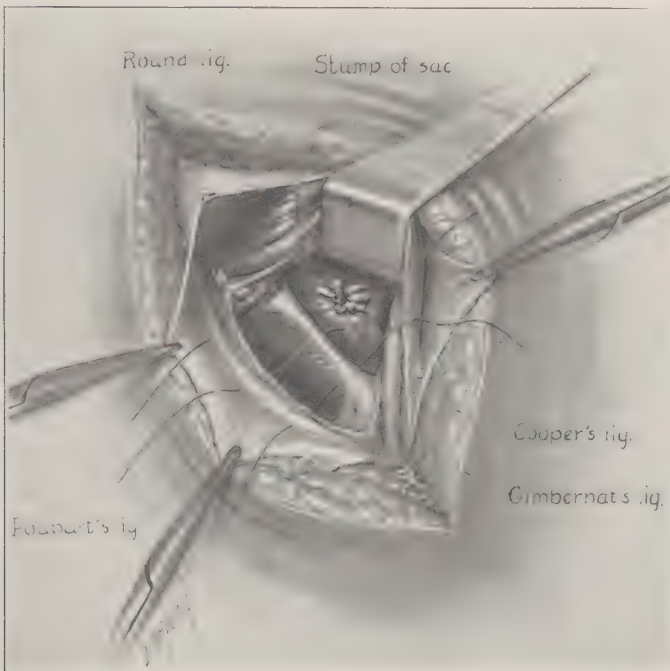


Fig. 122.—Inguinal operation for femoral hernia. Showing the ligation of the neck of the sac, Cooper's ligament and the suturing of the femoral ring.

guinal canal and to the outer side of it, and left the external ring intact. After ligating and excising the sac, he sutured the lower fibers of the transversalis and internal oblique over the cord to Cooper's ligament, then sewed Poupart's ligament to Cooper's ligament. If the inguinal canal was weak, he strengthened it by suturing the internal oblique and transversalis beneath the cord to Poupart's ligament. Similar methods were described by Gordon, Dujarier, Brandão, and others. Göbell strengthened the closure of the femoral opening with a strip of fascia transplant, $\frac{3}{4}$ by 4 inches (2 by 10 cm.), secured from the aponeurosis of the external oblique. This fascial band is passed through the internal oblique and transversalis muscles about 1 inch (2.5 cm.) above their lower margin, through the femoral opening and

a slit that has been made in the pectineal fascia, and the ends of the strip are sewn together.

Bérard devised an overlapping operation (*double rideau* or double curtain) which he performed as follows: After incising the aponeurosis of the external oblique parallel to Poupart's ligament and about one-third inch (1 cm.) above it, the internal oblique and transversalis muscles are separated and retracted. The sac, which has previously been freed by the femoral portion of the incision, is drawn up above Poupart's ligament, ligated and resected. A mattress suture is passed from below upward through Gimbernat's ligament, and taking a good bite in the transversalis, internal oblique, and the upper flap of the aponeurosis of the external oblique, the needle passes down through the femoral canal near the femoral vein, and finally takes a bite in the pectineal fascia and muscle. When this mattress suture is tightened and tied the transversalis, internal oblique, and aponeurosis of the external oblique are drawn down into the inguinal canal and united to the pectineal fascia. Finally, the inferior border of the aponeurosis of the external oblique is drawn upward, and sutured to the surface of the upper flap of the aponeurosis.

Chaput, in 1904, used a similar operation, laying emphasis on the closure of the space next to the femoral vein, and in 1916 he recommended placing a pedunculated fat graft two by four inches (5 by 10 cm.) behind the femoral ring in large hernias. The strip of subcutaneous fat is left attached over the pubis, while the free end is carried down and sutured to Cooper's ligament and Gimbernat's ligament.

The Operation for Strangulated Femoral Hernia.—The operation for strangulated femoral hernia is more difficult than for the nonstrangulated variety. Strangulated femoral hernia can be operated on by the femoral or inguinal route. Partial strangulation or *nipping* of a portion of the lumen of the intestine (Richter's hernia) should always be thought of, as it is more frequent in the femoral variety of hernia than in any other. In this form of strangulation obstruction is not complete, and operation should not be undertaken even when the symptoms of strangulation are indefinite, as gangrene occurs early in partial strangulation, just as it does when strangulation is complete.

The Femoral Route.—The skin incision is made parallel to Poupart's ligament, with its center over the most prominent part of the hernia. It is usually longer than is required for reducible hernia. The dissection is cautiously carried down through the subcutaneous tissues and fat to the sac, which usually is dark red or bluish black in color. The sac should be freed up to the femoral ring before it is opened. In case it is impossible to isolate the sac, it is necessary to divide its coverings very carefully, either on a grooved director, or by picking up each layer separately and dividing it between tissue forceps. The sac should be opened with the greatest caution.

always bearing in mind the possibility of bladder wall or sliding hernia being inside of it. After the contents are examined, the constricting point should be located. This is usually the sharp edge of Gimbernat's ligament at the femoral ring; less often the constriction is in the cribriform fascia. Blakeway maintained that strangulation was sometimes due entirely to a thickening of the neck of the sac.

When the constriction is found, an attempt should be made to stretch it by digital dilatation, the pressure always being directed inward. If this is not sufficient, some surgeons pass a blunt forceps through the constricting ring and stretch it by opening the forceps; this procedure is dangerous and never to be recommended. The best plan is to retract the hernia at the neck outward, expose the fibrous margin of the constricting ring and carefully nick it under guidance of the eye on the inner side of the sac. I have found that a very superficial cut in Gimbernat's ligament is all that is necessary, as this makes the further dilatation of the ring by the finger an easy matter. It is only very rarely necessary to nick or divide Poupart's ligament to relieve the strangulation. When the constriction is relieved, diseased omentum is usually ligated and excised and the intestine, if viable, is returned to the abdomen.

If partial strangulation has resulted in a small gangrenous area, it is sometimes possible to turn the necrotic portion in and close the healthy mucosa over it by two layers of Lembert or continuous sutures. If the gangrene is extensive, it is necessary to do an intestinal resection or one of the procedures described under the chapter on strangulated hernia.

The only disadvantage of the femoral route for dealing with strangulated hernia is that it is often difficult, and sometimes impossible, to do an intestinal resection without extending the incision upward through Poupart's ligament and entering the abdomen above the pubis. Sometimes, in order to get sufficient room to treat the gangrenous intestine, it is necessary to make an inguinal incision also; or, in other words, the combined operation is required.

The Inguinal Route.—Many surgeons prefer the inguinal route in operating for strangulated femoral hernia.

Perforation or Abscess in the Femoral Sac.—When femoral hernia is operated on by the inguinal route and the bowel is found perforated or an abscess has formed in the sac, no attempt should be made to remove the sac, but a femoral incision should be made to drain the wound. Schragger stitched the sac to the skin and used it as a drainage tube.

Tuffier called attention to the fact that the operation is facilitated if the omentum is divided as high as possible as soon as the sac is opened, before any attempt is made to reduce the intestine.

Ware suggested that when it is difficult to divide the constriction at Gimbernat's ligament, it is easily accomplished by passing a fine silk thread

through the femoral ring on a blunt needle and then gently whip-sawing the thread. The thread can then be used as a retractor to aid in reducing the hernia.

The Advantages of the Inguinal Operation for Femoral Hernia.—The inguinal operation for strangulated femoral hernia has these advantages: It gives a good view of the sac and contents; the constriction is quickly located and easily divided; an abnormal obturator artery is easily seen if present; there is more room to deal with the intestine, and resection or anastomosis, if necessary, can be carried out easily and without traction on the loops; and it also permits inspection of the intestine at a distance from the ring beyond the point of constriction.

Disadvantages of the Inguinal Operation.—One of the serious objections to the inguinal operation in strangulated hernia is the reduction of the more or less contaminated contents of the sac into the abdominal cavity. The inguinal incision opens Hesselbach's triangle, consequently there is always danger of a postoperative direct inguinal hernia, which is more difficult to cure than the original femoral hernia. The inguinal operation is more difficult and requires more time than the femoral route. It is more troublesome in males, on account of the obstruction of the cord, than in females. In obese subjects difficulty is usually encountered in suturing the conjoined tendon to Cooper's ligament.

Combined Abdominal and Femoral Incision.—Some surgeons prefer the combined femoral and abdominal incision in operating for femoral hernia, especially if strangulation is suspected. A good technic for the combined operation is as follows: An incision three inches (7.5 cm.) long is made with its first half over the inguinal canal parallel with Poupart's ligament. The second part curves down directly over the hernia. The aponeurosis of the external oblique is incised vertically, beginning at Poupart's ligament and extending downward along the border of the femoral vein for a distance of about one inch (2.5 cm.).

Poupart's ligament is separated in the direction of its fibers, the sac exposed and opened, the contents reduced and dealt with in the usual manner, and the sac ligated as high as possible. The divided edge of Poupart's ligament and the conjoined tendon are retracted upward. Cooper's ligament is exposed, and the conjoined tendon and the upper edge of the flap of Poupart's ligament sutured to it.

In dealing with strangulated femoral hernia through the combined inguinal and femoral incision, any omentum in the sac should always be ligated and excised before reduction is attempted. Gentle traction is made first on one and then on another portion of the strangulated loop, combined with light taxis on the tumor. It is usually a simple matter to reduce the hernia by this maneuver; however, if it is not immediately successful, it is necessary to enlarge the femoral ring by nicking Gimbernat's ligament.

Accidents During Operations for Femoral Hernia.—*Injury to the Bladder.*—The sac should always be examined very carefully. Bladder involvement should be suspected when the sac is thick, when it is covered by a quantity of lemon-colored properitoneal fat, or when there are numerous blood vessels on its surface. When the bladder is in the sac wall, it is nearly always on the inner side, and for this reason the sac should always be opened at a thin white point on the outer side. (See chapter on hernia of the bladder.)

Sliding Hernia.—When there is a sliding hernia of the large intestine, care must be taken not to open the intestine by mistake for the sac.

Injury to the Blood Vessels.—The surgeon must be on the lookout constantly for the deep epigastric artery and vein, the femoral vein, and an aberrant obturator artery. If the deep sutures are placed too close to the femoral vein, the pressure may result in a transient edema of the lower extremity, or rarely a thrombosis.

Piotrowski reported 108 operations for femoral hernia by the Kummer method, with the following accidents: The femoral vein was punctured once, the saphenous vein was punctured once, and the bladder was wounded once.

In a case reported by Black, the femoral vein was injured during an operation for strangulated femoral hernia. The hernia had been strangulated for forty hours, and there was considerable edema and discoloration of the tissues making it difficult to recognize the vein. The lateral ligature was applied to the cut in the vein and an uninterrupted recovery followed. Four weeks after the operation the entire lower extremity became swollen and edematous. This condition finally disappeared under treatment.

Willis related the experience of a physician who incised a saphenous varix by mistake for a femoral hernial sac. He was so surprised he fainted, and an assisting physician checked the hemorrhage, and probably saved the patient's life.

Gibbon reported an instance in which a surgeon punctured the femoral artery while suturing the femoral ring. He secured the cut with a hemostat and applied a lateral ligature. No complications followed the accident. The hernia recurred after a short time.

Kathan reported an accident that occurred in the practice of another surgeon. The femoral artery was punctured with the needle in closing the femoral opening. The artery was ligated to check the hemorrhage and when collateral circulation failed to establish itself, an amputation of the thigh was necessary. Kathan reported another instance in which marked swelling of the leg and thigh had persisted for nine years following an operation for femoral hernia. In a third case, a septic cystitis, which was thought to be due to catheterization, developed a week after operation. It disappeared in two weeks following the voiding per urethram of a chromic catgut ligature, which evidently had been used to tie off a portion of the bladder by

mistake for the sac, or else the bladder was perforated when the wound was closed.

Postoperative Treatment.—The postoperative treatment of strangulated and nonstrangulated femoral hernia is the same as for inguinal hernia. After an operation for femoral hernia, the patient should remain in bed from one to two weeks. (For further information, see postoperative treatment in chapter on inguinal hernia.)

Postoperative Complications.—*Perforation Following Reduction of Strangulated Hernia.*—Perforation of the intestine is rare. However, it may occur even when the intestine is viable at the time of operation. In case the hernia has been reduced by taxis, it is very important to watch the patient carefully for the first twenty-four hours for symptoms of gangrene or perforation.

Local Anesthesia for Femoral Hernia Operations.—I believe local anesthesia should be employed for all femoral hernia operations except in young children. It adds to the safety and comfort of the young and robust, and when the patient is handicapped by old age, shock, hemorrhage, pulmonie, nephritic or cardiac lesions, or when the hernia is strangulated, the local method is a necessity.

Operation for Femoral Hernia and Varicose Veins.—When there are varicose veins in the femoral region, they should be excised at operation for femoral hernia if the femoral route is used. A femoral hernia pressing on the internal saphenous vein is often the cause of varicose veins in subjects with large femoral hernias.

Recurrences.—I am convinced that a majority of the cases of recurrence following operation by the femoral route are due to the failure of the operator to close the femoral ring; he passes the deep sutures through the pectineal fascia, which forms the posterior margin of the femoral canal, mistaking it for Cooper's ligament.

Femoral hernias are usually slower in recurring after operation than other varieties, seldom recurring before the second year after operation. Reschke examined 170 patients several years after operation by the femoral route in which the opening was closed by a mattress suture; there had been only 3.5 per cent of recurrences. De Luca reported 57 operations by the femoral route with no recurrences.

Statistics I have collected from a number of clinics give the following results:

METHOD	NO. CASES	NO. RECURRENCES	PER CENT RECURRENCE
Femoral operation with closure of ring	469	19	4.05
Suturing Cooper's to Poupart's ligament	769	33	4.28
Muscle plastic operation (Salzer)	182	18	9.89
Operation by the inguinal route	206	10	4.85

Mortality Rate Following Operation for Nonstrangulated Femoral Hernia.—In 700 operations for nonstrangulated femoral hernia, including my own and those that I collected from the literature, there were 9 deaths (1.28 per cent).

Combined Operation for Femoral Hernia and Appendicitis Through the Inguinal Incision.—Some surgeons advise removing the appendix when it is nongangrenous but diseased, through the inguinal incision for femoral hernia. I believe, however, that the appendix should always be removed through a separate incision when appendicitis complicates either femoral or inguinal hernia.

Bibliography

FEMORAL HERNIA

- AHRENS, P.: Einklemmung des Magens in Schenkelbruch. *Zentralbl. f. Chir.*, Leipz., 1920, xlvii, 1345-1346.
- ANDREWS, E.: A new operation for femoral hernia. *Illinois M. J.*, Oak Park, 1923, xliii, 29-291.
- ANNANDALE, T.: Case in which a reducible oblique and direct inguinal and femoral hernia existed on the same side, and were successfully treated by operation. *Edinb. M. J.*, 1875-1876, xxi, 1087-1091.
- ARNAUD, G.: A dissertation on hernias or ruptures. Lond., A. Millar, 1748, p. 133-136.
- BÄHR, F.: Der äussere Schenkelbruch. *Arch. klin. Chir.*, Berl., 1898, lvii, 59-72.
- BALDWIN, A.: The radical cure of femoral hernia. *Lancet*, Lond., 1906, ii, 150-152.
- BALL, C. B.: The radical cure of hernia by torsion of the sac. *Brit. M. J.*, Lond., 1884, ii, 461-462.
- BANKS, W. M.: On the radical cure of hernia, by removal of the sac and stitching together the pillars of the ring. *Brit. M. J.*, Lond., 1882, ii, 985-988.
- BARBETTE, P.: *Opera. chirurgico-anatomica*. Lugduni, J. à Gelder, 1672, p. 26-30.
- BARDESCU, N.: Die Leistenmethode in der Operation der Schenkelbrüche. *Arch. f. klin. Chir.*, Berl., 1908, lxxxv, 453-487.
- BARKER, A. E.: On thirty-five operations for the radical cure of hernia by original methods. *Brit. M. J.*, Lond., 1887, ii, 1203-1205.
- BASSINI, E.: *Nuovo metodo operativo per la cura radicale dell'ernia crurale*. Padova, A. Draghi, 1893.
- BASSUEL: See Richter, A. G.: *Traité des hernies*. Trad. de l'allemand par. J. C. Rougemont. Bonn, J. F. Ashoven, 1788, ii, 139.
- BATTLE, W. H.: A very large femoral hernia. *Tr. Clin. Soc.*, Lond., 1903-1904, xxxvii, 245-247.
- BECKMAN, E. H.: The repair of herniæ from the peritoneal side of the abdominal wall. *Ann. Surg.*, Phila., 1912, iv, 570.
- BÉRARD, L.: Sur la cure radicale de la hernie crurale par le procédé inguino-crural du double rideau. II cong. de la Soc. internat. de chir. Rap., Brux., 1908, i, 403-405.
- BERGER, P.: Résultats de l'examen de dix mille observations de hernies. Cong. franç. de chir. Proc.-verb. [etc.], Par., 1885, ix, 264-452.
- BERGER, P.: Hernies. In: *Traité de chirurgie*. Duplay, S. et Reclus, P. Paris, Masson, 1892, vi, 748-759.
- BEVERS, E. C.: The inguinal operation for the radical cure of femoral hernia. *Brit. M. J.*, Lond., 1912, i, 779.
- BILLEOTH, T.: See Camson, C.: De la cure radicale de la hernie crurale. Thèse, Lyon, 1893.
- BISHOP, E. S.: The radical cure of hernia. *Lancet*, London, 1890, i, 1169-1170; 1236-1237.
- BLACK, S. O.: Hernia: Traumatic and strangulated. *South. M. J.*, Birmingham, 1921, xiv, 625-629.
- BLAKEWAY, H.: Hernia of urinary bladder. *Lancet*, Lond., 1918, ii, 799-800.
- BOINET, A. A.: De la cure radicale des hernies. Paris, Thèse de concours, 1839.
- BORCHARDT, M.: Osteoplastischer Verschluss grosser Bruchpforten. *Beitr. z. klin. Chir.*, Tübing., 1898, xx, 305-314.
- BOTTINI, E.: Di un nuovo processo nella cura radicale delle ernie. *Riforma med.*, Napoli, 1891, vii, pt. 4, 265-266.

- BRANDAO, FILIHO, A.: Qual a melhor technica para se praticar a cura radical da hernia crural? *Brazil-med.*, Rio de Jan., 1920, xxxiv, 295-297.
- BRIGGS, C. E.: Internal closure of the femoral opening for hernia. *Ohio M. J.*, Columbus, 1914, x, 662-665.
- BRYANT, T.: Case of displaced strangulated femoral hernia in which the sac with its contents was displaced downwards and inwards, through an opening at the lower end of the femoral sheath, in front of the abductor muscles, on the inner side of Scarpa's triangle. *Tr. Clin. Soc., Lond.*, 1901-2, xxxv, 3-6.
- CALLISEN, H.: *Herniorum rariorum biga acta societatis medicæ hafiænæ. Haniinæ, 1777*, ii, 321.
- CAVAZZANI, F.: Un nuovo processo per la cura radicale dell'ernia crurale. *Clin. mod.*, Pisa, 1903, ix, 342-344.
- CEVARIO, L.: Ernia crurale prevascolare intravaginale ed ernia crurale commune omologa. *Arch. ital. di chir.*, Bologna, 1921, iii, 145-153.
- CHAPUT, H.: Hernie crurale. Cure radicale. Obturation du canal crural par un fragment de cartilage costal. *Bull. et mém. Soc. de chir. de Par.*, 1900, xxvi, 154-155.
- CHAPUT, H.: La cure radicale de grosses hernies crurales par le procédé du rideau et la suture des gaines. *Bull. et mém. Soc. de chir. de Par.*, 1904, xxx, 404-407.
- CHAPUT, H.: Traitement des grosses hernies crurales par la greffe adipeuse pédiculée. *Rev. de gynéc. et de chir. abd.*, Par., 1916, xxiii, 431-433.
- CHEVRIER, L.: Le ligament rond dans les hernies crurales. *Rev. de chir.*, Par., 1907, xxxv, 245-259.
- CHEYNE, W. W.: The radical cure of hernia, with a description of a method of operating for femoral hernia. *Lancet*, Lond., 1892, ii, 1039-1041.
- CLOQUET, J.: *Recherches anatomiques sur les hernies de l'abdomen*, Thèse, Paris, 1817.
- CODIVILLA, A.: Zur Radikaloperation der Schenkelhernien. *Centralbl. f. Chir.*, Leipz., 1898, xxv, 729-731.
- COLE, P. P.: Radical cure of femoral hernia by the inguinal route. *Brit. M. J.*, Lond., 1919, i, 763-764.
- COLEY, W. B.: The radical cure of femoral hernia. *Ann. Surg.*, Phila., 1906, xlv, 519-528.
- COLEY, W. B.: Hernia. In: *Keen's Surgery*, Phila., W. B. Saunders Co., 1908, iv, 71-77.
- COLEY, W. B.: Hernia. *Progr. Med.*, Phila., Lea & Febiger, 1914, ii, 17-23.
- COLEY, W. B.: Hernia. *Progr. Med.*, Phila., Lea & Febiger, 1919, ii, 26-29.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key. London, Longman, Rees, Orme, Brown & Green, 1827.
- COTTU AND KUSS, G.: Sac de hernie crurale, déshabité et ayant subi la transformation kystique, pris pour une tumeur kystique du ligament rond. *Bull. et mém. Soc. anat. de Par.*, 1904, xxix, 367-368.
- CUSHING, H. W.: An improved method for the radical cure of femoral hernia. *Boston M. and S. J.*, 1888, cxix, 546-548.
- DAVIS, J. D. S.: Moschcowitz's operation; inguinal route for femoral hernia. *Tr. South. Surg. & Gynec. Assn.*, 1915, xxviii, 458-462.
- DE GARMO, W. B.: The cure of femoral hernia; results of one hundred and ten operations by a single method. *Ann. Surg.*, Phila., 1905, xlii, 209-214.
- DE GARMO, W. B.: Abdominal hernia, its diagnosis and treatment. Phila., Lippincott, 1907.
- DELAGÉNIÈRE, H.: Nouveau procédé de cure radicale de la hernie crurale. *Arch. prov. de chir.*, Par., 1896, v, 61-76.
- DE LUCA, L.: Risultati clinici prossimi e remoti della erniotomia crurale radicale alla Parlavacchio. *Policlin.*, Roma, 1922, xxxix, sez. chir., 141-146.
- DEMEAUX, J. B. D.: Des hernies crurales. Thèse, Paris, 1843.
- DESMAREST, E.: Cure radicale de la hernie crurale par la voie inguinale. *Paris méd.*, 1911-12, p. 312-316.
- DESMAREST, E.: Appendicectomy et cure radicale de la hernie crurale par voie inguinale. *Presse méd.*, Par., 1912, xx, 984-985.
- DIDIER, R.: Contribution à l'étude de la cure radicale de la hernie crurale; résultats éloignés et avantages du procédé de Proust et Guibé modifié. Thèse, Paris, 1912.
- DOOLIN, W.: Inflamed appendix in a hernial sac. *Brit. M. J.*, Lond., 1919, ii, 239.
- DOWDEN, J. W.: A new operation for the cure of femoral hernia. *Surg. Gynec. & Obst.*, Chi., 1918, xxvii, 348-349.
- DUJARIER, C.: Cure radicale de la hernie crurale par voie inguinale. *J. de chir.*, Par., 1912, viii, 113-128.
- ECCLES, W. M.: Case of cruro-serotal hernia. *West Lond.*, M. J., 1914, xix, 212.

- EISENDRATH, D. N.: The inguinal route in femoral herniotomy. *Surg. Clin., Chi.*, 1920, iv, 49-60.
- FABRICIUS, J.: Über eine neue Methode der Radikaloperation von Schenkelhernien. *Centralbl. f. Chir., Leipz.*, 1894, xxi, 121-125.
- FABRICIUS, J.: Ueber die operative Behandlung von Kruralhernien. *München. med. Wehnschr.*, 1907, liv, 826-830.
- FAGGE, C. H.: The inguinal method of radical cure for femoral hernia. *Proc. Roy. Soc. Med., Lond.*, 1910-1911, iv, surg. sect., 165-168.
- FASANO, M.: Dell' ernia crurale pettinea del Cloquet. *Clin. chir., Milano*, 1910, xviii, 883-898.
- FERGUSON, A. H.: On the radical cure of inguinal and femoral hernia by operation. *Ann. Surg., Phila.*, 1895, xxi, 547-664.
- FERGUSON, A. H.: *Modern operations for hernia*. Chicago, Cleveland Press, 1907.
- FÖDERL: Wie durch eine Abänderung der Bassini'schen Naht in sicherer Weise die inguinale und crurale Bruchpforte gleichzeitig in einem Acte verschlossen werden könne. *Wien. klin. Wehnschr.*, 1898, xi, 545-546.
- FRANK, R.: Die operation der kruralen Hernie auf inguinalem Wege. *Wien. klin. Wehnschr.*, 1909, xxii, 1032-1037.
- FREY, R.: Zur Radical-Operation der Bruche. *Mitth. d. Ver. d. Aerzte in Steiermark. Graz.*, 1893, xxx, 121-129.
- DE GARAY, A.: Nuevo procedimiento para la curacion radical de la hernia crural. *Escuela de med., México*, 1903, xviii, 97-102.
- DE GARAY, A.: Algunas consideraciones sobre el canal crural desde el punto de vista de la anatomia quirúrgica. *Escuela de med., México*, 1913, xxviii, 73-84.
- DE GARENGEOT, R. J. C.: *Traité des operations de chirurgie*. 2nd ed. Paris, Huart, 1731, i, 236-253.
- GIBBON, R. L.: Surgical treatment of hernia. *Charlotte (N. C.) M. J.*, 1912, lxx, 1-3.
- DE GIMBERNAT, A.: Nuevo método de operar en la hernia crural. *Madrid*, 1793.
- GIUSTI, G.: Sopra un caso di ernia doppia con sacco unico. *Gazz. d. osp., Milano*, 1915, xxxvi, 1333-1335.
- GÖBEL, R.: Verbesserung der Lotheissen-Föderl'schen Radikaloperation der Schenkelhernien durch Anwendung der freien Aponeurosentransplantation. *Zentralbl. f. Chir., Leipz.*, 1913, xl, 1255-1257.
- GORDON, T. E.: The radical cure of femoral hernia. *Brit. M. J., Lond.*, 1900, i, 1338-1339.
- GRAY, H.: *Anatomy, descriptive and surgical*. A revised American ed. from the 15th English ed., by T. P. Pick and R. Howden. *Phila., Lea Bros.*, 1901, 359-360.
- GUIBÉ, M., AND PROUST, R.: Cure radicale de la hernie crurale. *Presse méd., Par.*, 1904, i, 145-147.
- GUY DE CHAULIAC: *Arte medica exercitatissimi Chirurgia*. Lugduni, Sebastian Honoratum, 1572, p. 125.
- HAMMESFAHR, A.: Zur Radikaloperation der Schenkelhernie. *Zentralbl. f. Chir., Leipz.*, 1904, xxxi, 1269-1271.
- HERZEN, P.: Über die Technik der Radikaloperation des Schenkelbruchs. *Zentralbl. f. Chir., Leipz.*, 1903, xxx, 994-996.
- HESSELBACH, A. K.: *Die Lehre von den Eingeweidebrüchen*. Würzburg, K. Strecker, 1829, p. 172-173.
- HOFMANN, A. H.: Die Verwendung der Vena saphena bei der Radikaloperation der Schenkelhernie. *Zentralbl. f. Chir., Leipz.*, 1921, xlviii, 1158-1159.
- JABOULAY, M.: See Douhairet, L.: Étude des procédés opératoires appliqués à la cure radicale de la hernie crurale. *Thèse, Lyon*, 1896.
- JOESSEL, G.: *Lehrbuch der Topographisch Chirurgischen Anatomie*. Ed. by W. Waldeyer. Bonn, F. Cohen, 1899, ii, 180.
- KAMMERER, F.: Remarks on the radical cure of femoral hernia. *Ann. Surg., Phila.*, 1904, xxxix, 982-990.
- KATHAN, D. R.: Accidents of hernia operation. *N. Y. State J. M., N. Y.*, 1913, xv, 200-202.
- KEITH, A.: The "saccular theory" of hernia. *Lancet, Lond.*, 1906, ii, 1398-1399.
- KOCH, D.: De hernia crurali. In: Haller. *Disputationum chirurgicarum*. Lipsiæ, M. G. Friderici, 1721, iii, 251-270.
- KOCHER, T.: *Chirurgische Operationslehre*. Jena, G. Fischer, 1897, p. 199-203.
- KOTZAREFF, A.: La hernie crurale est plus fréquente à droite qu'à gauche chez la femme. *Rev. méd. de la Suisse Rom., Genève*, 1918, xxxviii, 188-196.
- KUMMER, E.: Ueber ein Verfahren der Radikaloperation freier Schenkelbruche. *Deutsche Ztschr. f. Chir., Leipz.*, 1912, cxvi, 301-325.

- LANCE, M.: Travaux récents sur la cure radicale de la hernie crurale. *Gaz. d. hôp., Par.*, 1912, lxxxv, 1941-1944.
- LANDRY, L. H.: The inguinal approach in the cure of femoral hernia. *N. Orl. M. & S. J.*, 1918-1919, lxxi, 235-242.
- LAROCHE, G. P.: The intra-abdominal operation for femoral hernia. *Ann. Surg., Phila.*, 1922, lxxv, 110-112.
- LAUGIER: Note sur une nouvelle espèce de hernie de l'abdomen à travers le ligament de Gimbernat. *Arch. gén. de méd., Par.*, 1833, ii, 27-37.
- LE CLERC, R.: Hernie propéritonéale crurale. *Bull. et mém. Soc. de chir. de Par.*, 1913, n. s. xxxix, 437-439.
- LE GENDRE, E. Q.: Hernie crurale à travers le ligament de Gimbernat. *Gaz. méd. de Par.*, 1858, xiii, 200.
- LEQUIN, N.: *Traité des hernies.* Paris, 1665, p. 8.
- LOCKWOOD, C. B.: Hunterian lectures on the morbid anatomy, pathology and treatment of hernia. London, H. K. Lewis, 1889.
- LOCKWOOD, C. B.: A lecture on the radical cure of femoral hernia. *Clin. J., Lond.*, 1910, xxxvii, 321-324.
- LOTHEISSEN, G.: Zur Radikaloperation der Schenkelhernien. *Centralbl. f. Chir., Leipz.*, 1898, xxv, 548-550.
- LOTHEISSEN, G.: Zur Operation der Schenkelhernien. II Cong. de la Soc. Internat. de chir. Rap., Brux., 1908, i, 399-402.
- LUCAS-CHAMPIONNIÈRE, J.: See Termet, A.: Considérations sur la hernie crurale, sur la cure radicale par le procédé de Lucas-Championnière. Thèse, Paris, 1898.
- LUCID, M. M.: An intraperitoneal method for the radical cure of abdominal hernias. *Surg. Gynec. & Obst., Chi.*, 1908, vii, 568-572.
- MCARDLE, J. S.: The operative treatment of hernia. *Dublin J. M. Sc.*, 1899, evii, 14-30.
- MACWEN, W.: On the radical cure of oblique inguinal hernia by internal abdominal peritoneal pad, and the restoration of the valved form of the inguinal canal. *Ann. Surg., Phila.*, 1886, iv, 89-119.
- MARCHETTI, G.: Cura radicale dell'ernia crurale; nota intorno ad una modificazione di tecnica del metodo Bassini. *Riforma med., Napoli*, 1922, xxxviii, 83-84.
- MARCY, H. O.: The anatomy and surgical treatment of hernia. New York, Appleton, 1892.
- MAUCHART, B. D.: De hernia incarcerata nova encheiresi extricata. Tübing, 1722. *In: Haber. Disputationes chirurgicæ selectæ. Lausanne Bousquet*, 1755, iii, 75-96.
- MORTON, C. A.: The inguinal operation for the radical cure of femoral hernia. *Brit. M. J., Lond.*, 1912, i, 418-420.
- MOSCHCOWITZ, A. V.: Femoral hernia; a new operation for the radical cure. *N. York State J. Med., N. Y.*, 1907, vii, 396-400.
- MOSCHCOWITZ, A. V.: Prevascular femoral hernia. *Ann. Surg., Phila.*, 1912, lv, 848-856.
- MOULLIN, C. W. M.: Five cases of radical cure of femoral hernia; remarks. *Lancet, Lond.*, 1896, i, 479-480.
- MURRAY, R. W.: Is the sac of a femoral hernia of congenital origin, or acquired? *Ann. Surg., Phila.*, 1910, lii, 668-677.
- NARATH, A.: Ueber eine eigenartige Form von Hernia cruralis (prævascularis) im Anschlusse an die unblutige Behandlung angeborener Hüftgelenksverrenkung. *Arch. f. klin. Chir., Berl.*, 1899, lix, 396-424.
- NEWBOLT, G. P.: The radical cure of femoral hernia by the inguinal route. *Brit. M. J. Lond.*, 1921, i, 15.
- NICOLL, J. H.: Case operated on for femoral hernia, with an account of the operation carried out. *Glasgow M. J.*, 1902, lviii, 43-44.
- NICOLL, J. H.: The radical cure of severe femoral and inguinal hernia. *Ann. Surg., Phila.*, 1906, xliii, 114-132.
- OCHSNER, A. J.: Femoral herniotomy. *J. Am. M. Assn., Chi.*, 1906, xlvii, 751-754.
- PARLAYECCHIO, G.: Operazioni radicali di ernia crurale col metodo del Ruggi modificato. *Riforma med., Napoli*, 1893, ix, pt. 1, 496-498; 507-510.
- PARRY, R. H.: Radical cure of femoral hernia. *Brit. M. J., Lond.*, 1901, ii, 1136-1138.
- PERASSI, A.: Le gradazioni dell'ernia crurale. *Gior. di med. mil., Roma*, 1911, lix, 41-43.
- PIOTROWSKI, G.: Contribution à l'étude de la cure radicale de la hernie crurale par la suture en U. *Lyon chirurg.*, 1921, xviii, 715-729.
- PLATT, W. B.: The radical cure of hernia by implanting a section of sterilized sponge. *Johns Hopkins Hosp. Bull., Balt.*, 1897, viii, 44-46.
- PLUMMER, S. C.: Testing the viability of strangulated intestine. *Surg. Gynec. & Obst., Chi.*, 1911, xii, 528-529.

- POIRIER, P., AND CHARPY, A.: *Traité d'anatomie humaine*, 2 ed., Paris, Masson, 1901, ii, 485.
- PÓLYA, A.: Ein neues Verfahren zur Radikaloperation grosser Schenkelbruch. *Zentralbl. f. Chir.*, Leipz., 1905, xxxii, 489-494.
- REICH, A.: Ueber die inguinale Radikaloperation der Schenkelbrüche. *Beitr. z. klin. Chir.*, Tübing., 1911, lxxiii, 104-115.
- RESCHKE, K.: Zur Kummerschen Operation der Schenkelhernien. *Deutsche Ztschr. f. Chir.*, Leipz., 1922, clxviii, 91-100.
- RIBERA Y SANS, J.: Hernie de l'enfant. II Cong. de la Soc. internat. de chir. Rap., Brux., 1908, i, 411-415.
- RICHARDSON, E. H.: Note on saphenous varix simulating a femoral hernia. *Ann. Surg.*, Phila., 1918, lxxvii, 471-472.
- ROSS, G. G.: Strangulated gangrenous perforated femoral hernia without symptoms, complicated by suppurating adenitis. *Tr. Phila. Acad. Surg.*, 1905, vii, 141-142.
- ROUX: Nouveau procédé de cure radicale de la hernie crurale. *Anjou méd.*, Angers., 1899, vi, 21-23.
- RUGGI, G.: Del metodo inguinale nella cura radicale dell'ernia crurale. Bologna, N. Zanichelli, 1893.
- SALZER, F. A.: Ein Vorschlag zur Radikalheilung grosser Cruralhernien. *Centralbl. f. Chir.*, Leipz., 1892, xix, 665-669.
- SAVINI, C.: The operation for femoral hernia with a suprapubic incision. *N. York M. J.*, 1921, cxiv, 451-454.
- SCHRAGER, V. L.: Routine appendectomy through right indirect inguinal hernial sac in afebrile cases. *Surg. Clin.*, Chi., 1919, iii, 387-389.
- SCHWARTZ, E.: Sur un procédé de cure radicale des hernies et en particulier des hernies crurale et inguinale; myoplastie herniaire. *Cong. franç. de chir. Proc. verb. [etc.]*, Par., 1893, vii, 689-693.
- SCOTT, N. S.: Two right-sided femoral hernias in the same patient. *Surg. Gynec. & Obst.*, Chi., 1910, xi, 531.
- SEAWELL, J. W.: Strangulated femoral hernia containing an undeveloped kidney. *Calif. State J. M.*, San Fran., 1912, x, 166-167.
- SEELIG, M. G., AND TUHOLSKE, L.: The inguinal route operation for femoral hernia; with a supplementary note on Cooper's ligament. *Surg. Gynec. & Obst.*, Chi., 1914, xviii, 55-62.
- SERAFINI, G.: Sulle varietà dell'ernia crurale e particolarmente sull'ernia crurale retrovascolare intravaginale e sull'ernia pettinea. *Polielin.*, Roma, 1917, xxiv, sez. chir., 230; 264; 273.
- SHIELS, G. F.: An unusual case of strangulated femoral hernia, with comments thereon. *Med. Rev. of Rev.*, N. Y., 1911, xvii, 176-179.
- SICK, P.: Radikaloperation des Schenkelbruchs durch Pektineusplastik. *München. med. Wehnschr.*, 1911, lviii, 1003-1005.
- SKILLERN, P. G.: Two suggestions in abdominal operative technic [etc.]. *J. Am. M. Assn.*, Chi., 1921, lxxvi, 445-446.
- SOCIN, A.: Ueber Radikaloperation der Hernien. *Arch. f. klin. Chir.*, Berl., 1879, xxiv, 391-398.
- SPIEGEL, B.: Einklemmung des Magens im Schenkelbruch. *Zentralbl. f. Chir.*, Leipz., 1920, xlvii, 373-374.
- STONHAM, C.: The radical cure of femoral hernia. *Lancet*, Lond., 1892, ii, 1198.
- TAIT, L.: On the radical cure of exomphalos. *Brit. M. J.*, Lond., 1883, ii, 1118-1119.
- TESTUT, L.: *Traité d'anatomie humaine*. Paris, O. Doin, 1905, i, 837.
- THIRIAR, J. A.: Utilité d'un transplant osseux dans la cure radicale des hernies. *Cong. franç. de chir. Proc. verb. [etc.]*, Par., 1893, vii, 318-323.
- TRENDELENBURG, F.: Zur Radikaloperation der Hernien. *Verhandl. d. deutsch. Gesellsch. f. Chir.*, Berl., 1890, xix, 133-134.
- TRICOMI, E.: Nuovo metodo operativo per la cura radicale dell'ernia crurale. *Riforma med.*, Napoli, 1891, vii, pt. 2, 556-558.
- TUFFIER, T.: Opération de la hernie crurale par voie inguinale. *Rev. de chir.*, Par., 1896, xvi, 240-248.
- VALLAS, AND PERRIN, E.: Cure radicale de la hernie crurale par la voie inguinale, sans fermeture de l'anneau crural. *Lyon chirurg.*, 1908-09, i, 757-766.
- VELPEAU, A. A. L. M.: *Nouveaux éléments de médecine opératoire*. Paris, Baillière, 1839, iv, 218-232.
- VERHEYEN, P.: *Corporis Humani Anatomia*. Lipsiæ, Thomam Fritsch, 1699, p. 64-65.

- WARE, M. W.: A safeguard in inguinal route operations for femoral hernia. *Surg. Gynec. & Obst., Chi.*, 1918, xxvii, 530.
- WERNECK, C.: Da via inguinal na cura des hernias cruraes. *Brazil-med., Rio de Jan.*, 1914, xxviii, 51-53.
- WILLIS, M.: Hernia and its treatment. *Old Dominion J. M. & S.*, Richmond, 1909, viii, 30-38.
- WILMS: Radikale Operationen des Schenkelbruches durch Faszienplastik. *München. med. Wehnschr.*, 1911, lviii, 293.
- WOOD, J.: Hernia and its radical cure. *Brit. M. J.*, Lond., 1885, i, 1185-1189; 1233-1237; 1279-1283.
- ZUCKERKANDL, O.: Anatomischer Beitrag zur Operationstechnik bei Schenkelhernien. *Arch. f. klin., Chir., Berl.*, 1882-1883, xxviii, 214-216.

CHAPTER XV

UMBILICAL HERNIA

Definition.—Umbilical hernia is a protrusion of abdominal viscera through the umbilical ring.

Umbilical hernia may occur through an orifice which has failed to close in embryonic life, or through the umbilicus which closed at birth and pathologically opened in infancy or adult life. These hernias may be congenital or acquired, and are most conveniently considered by dividing them into 3 classes: Congenital hernia of the cord; umbilical hernia in infants; and umbilical hernia in adults.

A. CONGENITAL HERNIA OF THE CORD

Synonyms.—Congenital umbilical hernia; Amniotic hernia; Omphalocele congenitalis; Hernia funiculi umbilicalis; Ectopia viscerum.

Strictly speaking, this condition is not a hernia because, as pointed out by Malgaigne, the viscera have never entered the abdominal cavity. As early as 1691, Ruysch called attention to the fact that an umbilicus is not developed in these cases. The condition is really an eventration that is due to maldevelopment of the embryo, and is considered under umbilical hernia, only because, from a surgical standpoint, it is customary to do so.

B. UMBILICAL HERNIA IN INFANTS

Synonyms.—Infantile umbilical hernia; “Starting of the navel.”

C. UMBILICAL HERNIA IN ADULTS

Synonyms.—Hernia of the umbilical ring; Hernia umbilicalis.

Historical.—The mechanical treatment of umbilical hernia dates back to very early times. Celsus, the famous Roman physician of the first century A.D., used compresses and bandages very much as we do today. He wrote: “And if the intestine comes down in a young child, a bandage must be made trial of before the knife; for this purpose a roller is used, to which in one part a bolster is sewed made of cloths, which is applied under the intestine to repel it; and then the rest of the roller is bound tight about him; by means of which, the intestine is often forced in, and the coats are agglutinated together.”

Heister, in the 18th century, cut a plate of lead, large enough to cover the hernial opening, covered it with linen or leather and fitted it over the orifice, holding it in place with a bandage. Suret, in 1787, devised an ingenious truss with a spring pad, and bands passing back along the truss and fastening to the frame near the back of the appliance. The coiled spring was adjusted so as to make increased pressure on the hernia when the patient strained, sneezed or coughed. Early in the last century, Trousseau treated infantile umbilical hernia by placing a tampon of wadding a little larger than the hernia over the tumor, and holding it in place by a diachylon plaster. About the same time, Malgaigne devised a stem or ball truss.

On account of the favorable location of umbilical hernia, it was more frequently subjected to operation in ancient times than the other varieties. Celsus used the elastic ligature in the treatment of umbilical hernia. He first placed the patient on his back to favor the return of the omentum and intestine into the abdominal cavity. Usually he opened the sac to make certain the contents were reduced; then he applied a double ligature to the sac, and seared the stump with caustics or the actual cautery to secure a firm cicatrix.

This method was widely used and kept alive through the centuries by the writings of Paulus Ægineta, the celebrated Greek surgeon, who practiced in Alexandria during the 7th century; Avicenna, who lived in the 11th century, the most famous of the Arabian physicians; Guy de Chauliac, the eminent French surgeon, who wrote a treatise on surgery in the 14th century; Paré, "the father of French surgery," who lived in the 16th century; de Garengot; Saviard, and Petit. The ancient forms of treatment were gradually displaced by other methods and were only revived with the advent of the antiseptic period of surgery.

Little change has been made during all these centuries in the method originally used by Celsus; the chief point of contention always being whether or not the sac should be opened before ligating. With the advent of the antiseptic era and the safety and success of the radical operation established, the ligature method has fallen into disuse.

The operative treatment for strangulated umbilical hernia employed by the early surgeons was limited to the incision of the gangrenous mass. The mortality rate was high, due to peritonitis and the development of fecal fistula. Cooper recognized the importance of closing the abdominal wound with sutures, to lessen the danger of peritonitis when operating for non-gangrenous, strangulated umbilical hernia. Scarpa, in 1819, stated that the reason most operations for strangulation were unsuccessful, was because they were performed too late. Many surgeons at this period advised against operative intervention in all hernias. The history of the nonoperative treat-

ment of umbilical hernia is replete with such complications as peritonitis and rupture of the intestine.

The radical operation for nonstrangulated umbilical hernia is of recent origin: Bérard, in 1841, was the first to operate for the congenital variety. MacDonald, in 1890, was able to collect from the literature 19 operations for this condition, with 17 cures and 2 deaths. Storer, in 1864, was probably the first in the United States deliberately to undertake to cure a nonstrangulated umbilical hernia in an adult, by radical operation. Primary union resulted and the patient was cured.

The earliest attempts at radical cure were directed toward suturing together the edges of the sac. This method was soon abandoned because it was almost always followed by recurrence. Later, the wound was closed with through-and-through sutures, which did not materially lessen the recurrence. Some operators closed the wound in layers; Quénu used six layers of sutures, while others retained the sac and used it as a pad to close the opening. The recurrence remaining high, further attempts were made to strengthen the closure by overlapping or crossing over the recti muscles. (Goldspohn, Graser, Hartmann, Dauriac, Pfannenstiel, and others.)

Wood, in 1863, and other early operators performed a subcutaneous lacing up of the umbilical ring with wire, which was either sharpened on one end or else threaded in a needle and passed in-and-out through the transversalis fascia, forming a pursestring suture of the opening.

Storer, Michael, and Keen were among the first to practice excision of the umbilicus. Warren observed that it was often easier to close the wound from above downward than from side to side.

The modern operation dates from the overlapping of layers of fascia by Lucas-Championnière, in 1881; Mayo, in 1894, was the first to propose transverse overlapping. Important papers on the closure of the umbilical hernial opening by fascia flaps have been published by De Garmo, in 1899; Sapiejko, in 1900; Piccoli, in 1900; Blake, in 1901; and Noble, in 1906. Other important papers on umbilical hernia have been published by Quénu, Condamin, Ransohoff, Kelly, Delatour, Moschowitz, Finsterer, McGlannan, Ludington, Coley and Hoguet, Buford, Montoya, and others.

Etiology

A. Congenital Umbilical Hernia.—The cause of embryonic hernia is an error in development. The viscera fail to regress into the abdominal cavity and the visceral plates do not close to form the umbilicus, as they normally should, at the third month of intrauterine life. A majority of the congenital hernias are of the embryonic type. Congenital hernias of the fetal period develop after the obliteration of the umbilical orifice, which takes place at the end of the third month of intrauterine life.

There is little known regarding the developmental causes of these hernias.

Many theories have been advanced, but none of them have much practical value, although they are of some historic interest. Cruveilhier believed that congenital hernia is due to pressure on the abdomen of the fetus as it lies in a faulty position. Scarpa thought it might be produced by traction exerted on the cord by its winding about the body of the fetus. Ahlfeld suggested that it might be caused by the constant pulling of the vitelline duct on the intestines in the root of the umbilical cord. St. Hilaire was of the opinion that accidental bands of adhesions held the viscera outside the abdomen, thus preventing the opening from closing.

B. Umbilical Hernia in Infants.—The exciting causes of infantile umbilical hernia are: Any sudden increase in intraabdominal pressure, such as a fall, whooping cough, flatulence, phimosis, and constipation. A large umbilical cord may act as a predisposing cause of delayed cicatrization of the umbilicus.

C. Umbilical Hernia in Adults.—After the age of three, umbilical hernia is rare until the age of 25, when it rapidly increases in frequency until forty years is reached. It decreases only slightly up to 55 years, when it again becomes rare. Obesity and pregnancy are the principal causes:

Obesity.—Obesity increases intraabdominal tension, as the result of the deposit of fat in the omentum, mesenteries, and anterior abdominal wall. The weight of this mass puts a strain on the abdominal muscles, which relax, atrophy, and separate at the weakest point—the umbilicus.

Pregnancy.—The distention of the abdomen during pregnancy weakens the anterior abdominal muscles; the flaccidity after delivery, with the tendency to obesity that follows repeated pregnancies, explains why a majority of these hernias are found in women.

Other Causes.—Violent exercise, falls, or any form of overexertion may produce umbilical hernia. Rapid emaciation of an obese individual by diet or disease, and suppuration in the region of the umbilicus, may act as predisposing causes. Umbilical hernia may attain large proportions unless properly treated in the early stages. In nulliparae the most frequent predisposing causes are: Fibroids of the uterus, cysts, ascites, and tumors of the ovaries.

Anatomy

Surface Anatomy.—The variations in the contour of the abdomen in the umbilical region are marked, depending on the age, sex, occupation, and muscular development of the individual. Obesity plays an important rôle, especially in the female.

In the male and in children, the abdomen is wider above the umbilicus, while in the adult female the widest portion is below. (Fig. 123.) The umbilicus marks the most prominent part of the abdomen. It is usually below the mid-point between the intrasternal notch and the symphysis pubis, and a little below the highest part of the iliac crest, and opposite the middle of

the body of the fourth lumbar vertebra. When the abdominal muscles have lost their firmness and tone as a result of age, disease, repeated pregnancies or obesity, the umbilical region becomes prominent and more or less pendulous, so that the umbilicus loses its normal contour and often lies considerably below the normal level. In the child it is lower relatively than in the adult, because of the undeveloped state of the pelvis.



Fig. 123.—The normal umbilicus. Showing the linea alba and the recti muscles.

To determine the usual position of the umbilicus, Niwase examined 1,090 Japanese women in the recumbent posture. He found that in 86.8 per cent the navel was situated at the vertex of a right triangle based on a line connecting the symphysis pubis and the anterior superior iliac spines. The distances were the same between the navel and the anterior superior iliac spine;

between the anterior superior iliac spine and the symphysis pubis; and between the symphysis pubis and the anterior superior iliac spine. Niwase calls this space the *umbilical right triangle*.

A. Congenital Umbilical Hernia.—In congenital umbilical hernia the anterior abdominal wall fails to close in the region of the navel, owing to a defect or error in development during intrauterine life. These large congenital hernias are frequently covered by a thin transparent membrane that is continuous with the parietal peritoneum. In the smaller hernias the only contents may be a knuckle of intestine or a Meckel's diverticulum, which protrudes into the cord and separates the structures (*hernia at the root of the cord*); in these cases the intestine should be returned into the abdomen before the cord is tied.

Congenital Umbilical Hernia and Other Malformations.—Other malformations may exist along with congenital hernia. Among the defects that have been observed are: Atresia of the large intestine, imperforate anus and ureter, exstrophy of the bladder, meningocele, spina bifida, sacrocoecygeal tumor, club foot, polydactylism, harelip, cleft palate, hypospadias, and epispadias.

Of 16 cases of congenital umbilical hernia collected from the literature by Hertzfeld, 12 were found with one malformation, or more than one; cleft palate was found 4 times; spina bifida 4 times; meningocele once; exstrophy of the bladder 5 times, and vesical fistula 3 times.

Embryology.—During the early weeks of embryonic life, the small intestine communicates with the umbilical vesicle by means of the vitelline duct. The ventral surface of the embryo is incomplete, and is joined to the blastodermic vesicle by a pedicle, which is the cutaneous umbilicus. The umbilical vesicle passes through the cutaneous umbilicus, and after the third week, the allantoic vesicle passes through. The internal opening of the vitelline duct is the intestinal umbilicus. In the fetus as well as in the adult, when the vestige of this canal persists to form a Meckel's diverticulum, the loop of small intestine in which it is inserted is called "the vitelline loop."

As the embryo develops, the lumen of the intestinal umbilicus or vitelline duct becomes narrower, and at the same time, the cutaneous umbilicus contracts. The lower portion of the small intestine and usually the cecum are outside of the peritoneal cavity in the umbilical cord. As the small intestine increases in length and forms loops in the abdominal cavity, it exerts traction on the intestine outside the abdomen, gradually drawing it into the cavity.

The base of the ectodermic pedicle tends to close over the viscera by the concentric progression of a very thin membrane, the "inferior uniting membrane" of Rathke. The cutaneous umbilicus becomes more and more narrowed, and the intestine is retracted from the region of the umbilical cord. By the end of the third month, the vitelline and allantoic pedicles

entirely atrophy; the abdominal walls close in around the umbilical vesicle, and all that is left is a firm connective tissue depression in the abdominal wall; this is the umbilical ring, and it is traversed by the placental vessels.

The peritoneum, which is prolonged into the umbilical cord, retracts more and more, and in the later months of intrauterine life, all that remains is a small depression in the region of the umbilicus. The skin, which extends one-half inch (1.25 cm.) up on the cord, is separated by an irregular line from the amniotic covering. When the skin around the umbilicus is replaced by amnion, the defect is known as *amniotic umbilicus*, a term suggested in 1881 by Nicaise, who observed that the strength of the abdominal wall is not impaired by this condition, and that the opening usually closes spontaneously.

With the presence of an excessive amount of amnion, the *amniotic umbilicus* is a predisposing cause of congenital hernia of the cord. The cause of this malformation is not known, but the following factors are important: An excess of amnion; delayed recession of intestine into the abdomen; the infolding of amnion along the cord and skin; and an excessively large cord, or lack of skin.

The size of the hernia depends on the amount of skin lacking, the condition of the surrounding muscles, and the degree of intraabdominal pressure. The hernia is covered by amnion and a thin layer of peritoneum; between these, there is usually a layer of Wharton's jelly. The sac is thin and translucent and the organs can be plainly seen through it. It is freely movable over the viscera, unless inflammation has occurred and adhesions have formed. The large hernias are almost always irreducible, as the abdominal cavity has adapted itself to its customary contents.

Parts Passing Through the Umbilicus in Fetal Life.—The structures passing through the umbilicus during fetal life are: The urachus, umbilical arteries, umbilical vein, some of the fetal membranes, and a portion of the digestive tract.

Normal Closure of the Umbilicus.—The umbilical ring closes after birth because it has no further function to perform. The contents of the arteries and vein clot, and the whole mass is converted into connective tissue. The umbilical ring contracts, and the result is a firm scar at the site of the umbilicus with fibers decussating above it; one set across the median line, and two sets of circular fibers interlacing upon the lateral aspects of the umbilicus. A few days later, after the cord is tied, the elastic fibers of the umbilical ring contract and the stump separates on a level with the abdominal wall. The urachus, umbilical vein, and two allantoic or hypogastric arteries are cut off by the contracting umbilical ring. The slender connective cords representing these obliterated vessels, converge toward the umbilical cicatrix, the vein from above, and the arteries from below. As the umbilical cicatrix becomes firmer, and the growth of the abdomen continues, these cords become tense

and the umbilicus is drawn inward, more markedly at the lower portion, where the stronger cords of the urachus and umbilical arteries are firmly attached to the ring. The cord representing the umbilical vein is small and loosely attached to the upper edge of the ring, which feels sharp and can be felt more distinctly than the lower margin. After the age of two years, the umbilical cicatrix has become sufficiently firm to prevent the development of hernia in this region as long as the muscles maintain their normal size and do not become weakened by fatty deposits. (Fig. 124.)

B. Umbilical Hernia in Infants.—Infantile umbilical hernia usually develops during the first six months of life. Following a strain that increases intraabdominal tension, a knuckle of intestine forces an opening between the vein and the upper margin of the ring, where the umbilical scar tissue is the weakest.

These hernias are almost always small, and with a properly fitting abdominal binder they are often cured spontaneously because of the normal

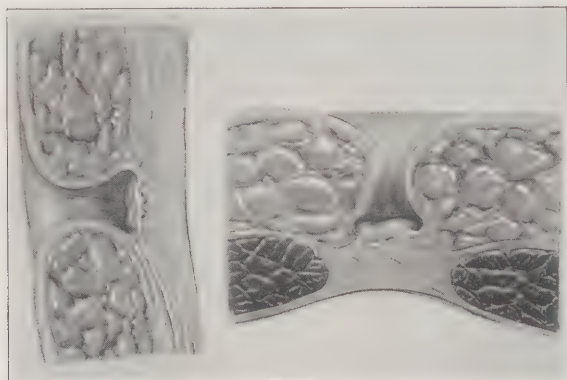


Fig. 124.—The umbilicus. Showing the firm cicatrix that forms after the normal closure of the opening. Mesial and transverse sections.

contraction of the umbilical and periumbilical scar tissue. After the age of three, umbilical hernia is rare until early adult life.

Size and Shape of the Hernia

A. Congenital Umbilical Hernia.—The linea alba closes first from the pubes to the umbilicus, and later from the ensiform cartilage downwards. For this reason, in the majority of cases, the opening is found to extend from the umbilicus half way to the ensiform cartilage. When the embryonic development is arrested early, the defect in the abdominal wall may be large, in rare instances extending from the manubrium sterni to the symphysis pubis.

The size of the hernia may vary from a slight protrusion no larger than the finger tip to a tumor the size of a fetal head. Most of these hernias are small, seldom being more than an inch (2.5 cm.) in diameter. They are pedunculated tumors which protrude through a dilated umbilical ring, and they

extend as a cylindrical mass for an inch or two (2.5 to 5 cm.) into the cord. The margin between the skin and the amnion is well defined, and they should never be mistaken for the cord alone. A number of cases are on record in which a portion of intestine or a Meckel's diverticulum has been tied off with the cord. The large hernias are oval or pear-shaped and the skin reaches only to the margin of the opening. The hernial contents are covered by a translucent membrane, whose lower portion is connected with the umbilical cord. (Figs. 125 and 126.)

B. Umbilical Hernia in Infants.—Infantile hernias may vary in size, from the *umbilical button*, which is no larger than the tip of the finger, to a tumor as large as an adult's head. Small hernias are usually spherical in shape,

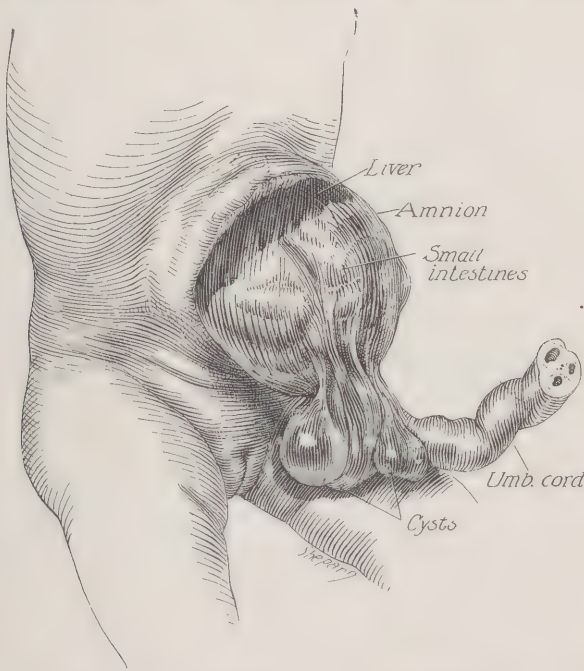


Fig. 125.—Congenital hernia of the umbilical cord. This condition is really an eventration due to maldevelopment of the embryo, as the viscera have never entered the abdominal cavity.

becoming conical as they increase in size. The sac is almost always adherent at the fundus or at the cicatrix.

C. Umbilical Hernia in Adults.—Small umbilical hernias in obese patients may not be noticeable and can be palpated only with difficulty. The hernia, as it enlarges, extends downwards; in some instances it has been known to reach below the knees and to render the patient an invalid. The large hernias, which burrow outward and downward between the skin and the muscles, are held by the firm fascia at the ring. Adhesion of intestine to the sac is rare, but omental adhesions form early between the contents and to the sac wall itself, especially at the fundus. The hernia becomes irreducible

early, and presents an irregular appearance owing to the intrasaccular adhesions. Strangulation may be due to the protrusion of a knuckle of intestine through an opening in the omentum, or in rare instances to constriction by the umbilical vein. The skin overlying the hernia is very thin and almost always presents one or more scars, the result of healed ulcerations.

Openings in the Sac.—While there is usually only one opening between the abdominal cavity and the sac, in very large hernias there may be two or more. Almost always these are false openings leading into different loculi in the sac, and they are due to adhesions of the omentum; however, there may be a second opening through the linea alba near the umbilical ring, and usually above it. Sometimes the openings in the linea alba lead into sep-

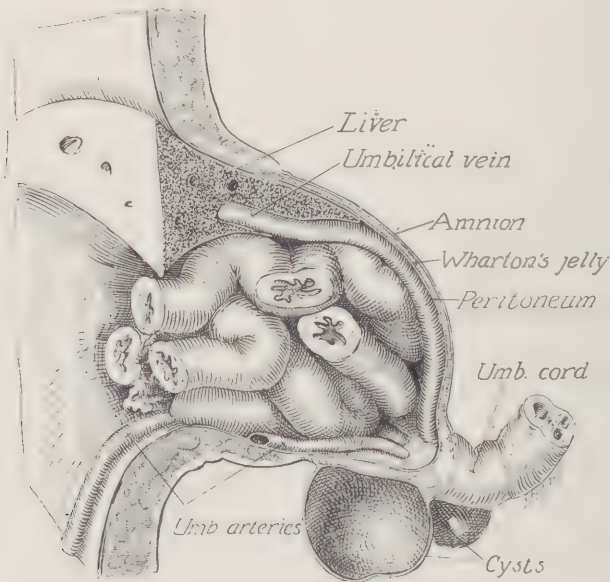


Fig. 126.—Congenital hernia of the umbilical cord. Mesial section showing the sac contents, the separation of the vessels, and two small cysts on the cord.

arate sacs lying side by side. The opening in the fascia is usually not over one to three inches (2.5 to 7.5 cm.). Several years ago, I operated on a patient who weighed 400 pounds and had a hernia that reached below the pubes, while the circular opening in the fascia through which the whole of the transverse colon and huge masses of omentum protruded, measured only one inch (2.5 cm.) in diameter.

Contents of the Sac

A. Congenital Umbilical Hernia.—There are two types of congenital umbilical hernia, embryonic and fetal:

1. *Embryonic Hernia.*—The contents of small embryonic hernias ordinarily consist of one loop or more of small intestine. Sometimes the cecum is

found in the sac, and occasionally a part of the liver. In 47 cases collected from the literature by Macready, the intestine was found alone in the sac 28 times; the intestine and liver, 9 times, and the liver alone, 10 times.

The very large hernias, or true eventrations, may contain part of the abdominal viscera, or all of it, even the pancreas; and also the lungs, heart, and pelvic organs. Rarely, the hernia may consist of a urinary diverticulum or a partial exstrophy of the bladder, which may have a fistulous opening lined with mucous membrane.

2. *Fetal Hernia*.—The fetal hernias are never as large as the embryonic variety, and almost always consist of small intestine and omentum. The parietal peritoneum protrudes in the region of the umbilical cord, and displaces the vein upward, separating the two arteries which are below. (Fig. 127.)

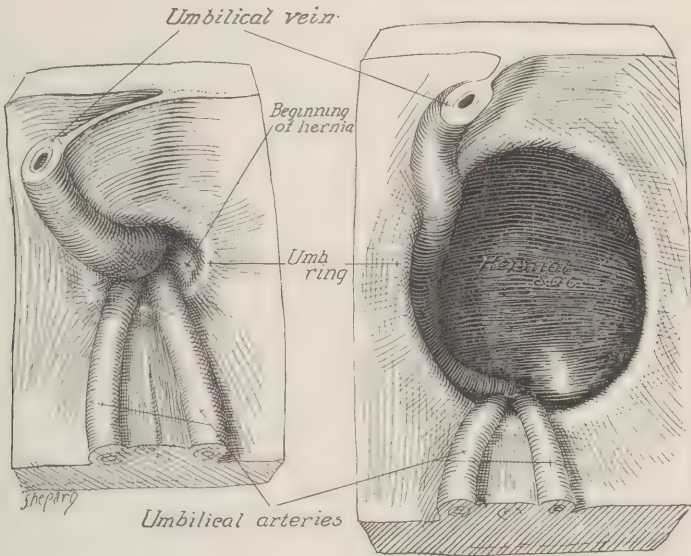


Fig. 127.—Congenital hernia of the umbilical cord. The peritoneal aspect. The small hernias are of the fetal type and contain small intestine and omentum. The umbilical vein is displaced upward, separating the two arteries which are below.

B. Umbilical Hernia in Infants.—In small infantile hernias the sac is empty, except when a knuckle of intestine is forced into it as the child cries or strains. Larger infantile hernias may contain one or more loops of small intestine and rarely a portion of transverse colon. If the hernia is neglected and allowed to increase in size, it may have the same contents as the adult variety.

C. Umbilical Hernia in Adults.—Umbilical hernia in adults always contains omentum, usually a loop of transverse colon, and sometimes small intestine. The stomach, liver, gall-bladder, spleen, pancreas, cecum, appendix, and sigmoid are rarely found. The omentum always lies in front and may form a complete lining of the peritoneal sac.

Hernia of Meckel's Diverticulum.—In 27 cases of umbilical hernia of Meckel's diverticulum that I collected from the literature, only 1 was in an adult. Nearly all of the patients were newly born infants.

The Uterus.—The uterus is sometimes found in the hernial sac. Instances are on record where the pregnant uterus, as it enlarges, enters the umbilical hernial sac, displacing the other viscera into the abdomen. It is usually possible to force the uterus back into the abdominal cavity, even at term; however, if it is irreducible, delivery by hysterotomy is necessary. (See chapter on hernia of the ovary, tube and uterus.)

In rare instances fatty tumors are found in the sac. They are usually attached to the large intestine and are most commonly hypertrophied appendices epiploicae. This was true in 7 of the 15 cases collected from the literature by Ruben.

Coverings of the Hernia

A. Congenital Umbilical Hernia of the Cord.—In the congenital umbilical variety the coverings of the hernia are amnion and parietal peritoneum.

B. Umbilical Hernia in Infants.—In the infantile umbilical variety the coverings are the peritoneum, transversalis fascia, superficial fascia, the fibrous tissue of the umbilical scar, the linea alba, and the skin.

C. Umbilical Hernia in Adults.—In adults the coverings of the hernia are the peritoneum, which forms the sac, the transversalis fascia and the skin. The coverings are usually very thin, especially over the fundus.

Frequency of the Varieties of Umbilical Hernia

A. Congenital Umbilical Hernia of the Cord.—Congenital umbilical hernia is very rare, occurring about once in every 10,000 births. Of 69 cases collected from the literature by Buschan 43 were in males, and 26 in females. In 151,691 newly born infants at the New York Lying-In Hospital, 152 had umbilical hernia at birth.

B. Umbilical Hernia in Infants.—Infantile umbilical hernia is very common during the first year of life. It is less frequent in the second year, and seldom occurs after the third year. It appears in both sexes with nearly equal frequency, being perhaps slightly more frequent in boys in whom it is often associated with inguinal hernia. About 50 per cent of the umbilical hernias in males appear in the first year, and in females only 20 per cent occur during this period.

C. Umbilical Hernia in Adults.—Umbilical hernia in adults begins to appear about the age of 20, and after this year it increases slowly in males, and rapidly in females owing to the beginning of the child-bearing period. Over 75 per cent of all cases occur in females.

Recurrence After Apparent Spontaneous Cure.—While a large percentage of infants are cured of umbilical hernia by truss or bandage treatment, there

is a small number in whom there is no response to these measures; others may be apparently cured, but if carefully examined the navel will be found relaxed, the ring enlarged, and a small peritoneal fossa still present. These hernias are liable to recur later in life following an exciting cause which increases intraabdominal pressure, such as trauma, obesity, pregnancy or abdominal tumors.

Symptoms and Diagnosis

A. Congenital Umbilical Hernia of the Cord.—The symptoms of congenital umbilical hernia are principally objective. There is a tumor in the umbilical region which is so apparent that it can scarcely be mistaken for any other condition. As intestine is usually in the sac, the tumor is tympanitic on percussion and there is a gurgling sound on manipulation. The small hernias can be reduced, but they immediately reappear. If the liver is in the hernia, a brown-colored mass can be seen through the sac and the tumor is only partially reducible. The stomach in the hernia gives rise to digestive disorders, such as colic and vomiting immediately after nursing. Hernias consisting of bladder diverticulum, present a fluctuating transparent tumor in the hypogastric region, which is frequently associated with imperforate urethra and retention of urine in the bladder and urachus.

Complications.—The sacs of large hernias may rupture in the uterus or during delivery. On account of the eventration or other defects, infants with congenital hernia of the cord usually do not live. The thin sac over the viscera quickly dries and is easily ruptured; or inflammation develops with ulceration at one point, or more, on the membrane. With the bursting of the sac, fatal peritonitis quickly follows. Instances of spontaneous recovery are very rare.

A fecal fistula may result if a part of the intestine or a Meckel's diverticulum is caught in the ligature of the cord. Instances of fatal peritonitis following this accident are also on record. Following straining or crying, a loop of intestine may protrude through the fistulous opening and become strangulated.

Gastric fistulas, due to ulceration of the stomach, while it is one of the hernial contents may rarely occur. Small urinary fistulas may close spontaneously, providing there is no obstruction in the urethra. Jaboulay and Patel have reported an instance in which the fistula closed in early life only to reopen in old age, when the patient developed urinary obstruction as a result of prostatic disease.

B. Umbilical Hernia in Infants.—Umbilical hernia is often overlooked until the baby is a few weeks old, and a tumor is noticed when it cries. The small spherical protrusion, which first appears, becomes conical in shape as it increases in size. (Fig. 128.) A small hernia frequently causes attacks of colic and the pain is relieved and the child stops crying as soon as the mass

is reduced. These hernias usually contain a knuckle of intestine only when the child cries; omentum is seldom found in the sac, and strangulation is rare.

Reduction is easily accomplished, especially if the child is suspended by the feet to keep it from crying. The ring is easily felt by the examining finger. If the edge of the orifice is sharp, the outlook for spontaneous cure is less promising than when it is broad and symmetrical.

Gastrointestinal symptoms similar to those found in the adult will be noticed if the omentum has become adherent to the sac wall. While this condition is unusual in children, it should always be borne in mind.

C. Umbilical Hernia in Adults.—Adult umbilical hernia may rarely be the persistence of the infantile form, or it may be a recurrence of an infantile hernia. As a rule, however, it first appears following an increase in



Fig. 128.—Umbilical hernia in a child.

intraabdominal tension and weakening of the muscle walls, which is usually caused by obesity or multiple pregnancies. The hernia increases most in size during the last weeks of pregnancy and at parturition. As in the infantile form, the adult hernia first protrudes through the *wcak spot* of the umbilical cicatrix at the upper part where the obliterated umbilical vein is loosely attached to the edge of the ring.

In early cases an expansile impulse is obtained when the patient coughs, and the tumor is reducible when he assumes the recumbent position. If the hernia is grasped between the fingers and lifted up, the contents may be felt to slip by the fingers. Umbilical hernia in adults first appears to come through the side of the ring, and for this reason has been termed “paraumbilical hernia.” As it increases in size, it assumes a rounded or oval shape with a marked tendency to sag downward, becoming pendulous. At this stage the hernia

appears to be in the midline. In addition to the dilatation of the umbilical ring, there is usually more or less diastasis of the recti. These hernias have no tendency to spontaneous cure; on the other hand, if left untreated they steadily increase in size and may reach large proportions, in some cases extending to the symphysis pubis or even to the knees.

The sac almost always contains more or less omentum, transverse colon or small intestine, and rarely other viscera. Early in the course of the hernia, the omentum becomes adherent to the sac wall, causing the mass to be partially or wholly irreducible. The large hernias often present several loculi or diverticula, which are formed by the adhesions between the omentum, or by the adhesion of omentum to the walls of the sac. Sometimes the intestinal contents are entirely enclosed by folds of omentum which have become matted together. On account of the exposed position of the hernia, it is subjected to considerable mechanical irritation, from corsets, trauma, rubbing of clothes, etc. The discomfort of a large umbilical hernia is often sufficient to make the patient a semi-invalid. Most patients complain of a dragging pain in the hernia if compelled to be on their feet for any length of time. In men umbilical hernia is usually associated with inguinal or femoral hernias.

When the greater omentum is adherent in the hernial sac, it produces traction on the stomach and transverse colon, which interferes with the peristaltic movements of the stomach and causes it to assume a vertical position. The gastrointestinal symptoms are often pronounced. Traction on the colon may cause attacks of colicky pain, constipation, nausea and vomiting.

Aaron has applied the term *umbilical dyspepsia* to those patients who have no demonstrable hernia but complain of indefinite gastrointestinal symptoms with nervousness. In these cases, severe pain follows pressure over the umbilicus. Strapping with adhesive tape or the wearing of an elastic belt usually affords relief.

Complications

1. **Gall-Bladder Disease.**—When the gall-bladder is part of the hernial contents, it is usually manifested by sudden abdominal pain between the umbilical region and the liver, which is aggravated by pressure over the 9th right costal cartilage, and may be so severe as to compel the patient to go to bed. Gall-stones, cholecystitis or gangrene of the gall-bladder may be found at operation. Cholecystectomy is usually indicated.

2. **Ascites and Umbilical Hernia.**—Ascites, due to cirrhosis of the liver or to an abdominal tumor, may enter the hernial sac, and if omental adhesions are absent or slight, the fluid may displace the viscera into the abdomen.

3. **Strangulation.**—Strangulation is rare in children, but is not uncommon in adults. Often the symptoms are obscure as the strangulation may be intrasaccular, and if the patient is very obese and the hernia small, palpable signs may be absent. With a history of umbilical hernia, the symptoms of intestinal obstruction, stercoraceous vomiting, etc., operative intervention is indicated.

Obstruction in umbilical hernia is frequent because of the tendency of the omentum to adhere to the sac walls. I believe paralysis of the intestine in the sac is sometimes a contributing cause of strangulation. The fundus of the sac, which is constantly exposed to mechanical irritation, is frequently the seat of ulceration, sometimes so extensive that it involves the peritoneum. If the peritonitis is localized, it usually results in a mass of adhesions. Occasionally the infection extends to the abdominal cavity. The diagnosis is very difficult if the symptoms simulate a superficial abscess of the abdominal wall.

4. **Rupture of the Sac.**—Sometimes the hernial sac will suddenly tear, after a strain or injury. Pott, in 1763, cautioned against the disastrous results following rupture of the sac during pregnancy. Usually the skin over the fundus of the sac is already the seat of ulceration. Operation should be performed at once; the earlier it is done the more favorable the prognosis. In the delayed operation almost all the patients die of peritonitis.

Johnson's patient applied a hot stove lid to relieve the colicky pain in the hernia. The skin ulcerated, and a few days later the sac ruptured, allowing intestine and omentum to protrude. Operation was undertaken 17 hours after injury. Death occurred seven days later from peritonitis. McGrath operated on a patient 4 hours after rupture, and Williams operated on one less than 8 hours after the accident; both of these patients recovered.

I observed an irreducible umbilical hernia in a woman 50 years old, with ulceration of the skin, of about two months' duration, over the most prominent part of the tumor. In this condition, the patient fell down stairs, the sac ruptured at the site of the ulcer and a small loop of intestine protruded. I operated five hours after the accident and she made an uneventful recovery.

The mortality rate from rupture of an umbilical hernial sac depends on the promptness of operation. During the first 12 hours it is 25 to 50 per cent, while those patients operated on 24 hours or more after the accident nearly all die, unless there are extensive adhesions in the sac to prevent intra-abdominal peritonitis.

Differential Diagnosis

A. **Congenital Umbilical Hernia of the Cord.**—There is small chance of mistaking congenital umbilical hernia for any other condition, excepting, possibly, hydrocele of the umbilical cord, which might be confused with a

urinary diverticulum. However, hydrocele can be excluded by the absence of vesical symptoms, and aspiration will show that the fluid is not urine.

B., C. Umbilical Hernia in Infants and Adults.—A subperitoneal lipoma, which may come through an opening in the linea alba is frequently mistaken for an umbilical hernia. These fatty tumors give no impulse on coughing, and do not disappear on manipulation or with change in posture.

Solid tumors, myomas, dermoids, cysts in the umbilical region, malignant tumors of the gastrointestinal tract, cysts, and syphilis involving the left lobe of the liver, may rarely be mistaken for umbilical hernia.

Prognosis

A. Congenital Umbilical Hernia of the Cord.—In small congenital umbilical hernia the outlook is fairly good if the condition is recognized early, the operation undertaken while the sac is still moist, and before the hernia has been increased in size by the taking of fluid into the stomach. Unless the hernia can be reduced and the opening closed by operation, the prognosis is very grave. Resection of viscera and incomplete closure of the defect is usually followed by death. Infants with large congenital hernia are often stillborn or die soon after birth. If other viscera, besides the intestine, are in the sac, the infant has small chance of surviving operative treatment. Infants with small congenital hernia are usually born alive, and the most favorable results have been secured when operation has been performed during the first few hours after birth. The mortality rate is about 10 to 20 per cent.

B. Umbilical Hernia in Infants.—Infantile umbilical hernia is usually cured spontaneously before the third year. It seldom persists into adult life. As strangulation is rare, the prognosis in these cases is good if the child is properly fitted with a binder or support.

C. Umbilical Hernia in Adults.—Umbilical hernia in adults carries a graver prognosis than the inguinal or femoral variety. Rapid growth of fat in the omentum within the sac, causes the hernia to become irreducible even if no adhesions have formed. As a rule, adhesions form early between the contents, and between the omentum and the sac walls. The transverse colon in the hernial sac tends to become dilated and as it is difficult for it to empty its contents, strangulation occurs frequently.

There is no tendency to spontaneous cure of adult umbilical hernia. Owing to the exposed position of the fundus of the hernia, either a poorly fitting truss or trauma may produce irritation and finally ulceration, which may result in perforation of the sac and fatal peritonitis.

On account of the sacculated condition of the hernia, it is important at operation to be on the lookout for a hidden strangulation of a small knuckle of intestine in one of the loculi. The mortality of operation for strangulated umbilical hernia is 10 to 50 per cent. The causes of death following opera-

tion for the large hernias can be most conveniently divided into three groups, namely: 1. Death due to cardiovascular and renal complications, dilatation of the heart, pulmonary edema, pneumonia, uremia, apoplexy, embolism and thrombosis.

2. Death caused by postoperative abdominal conditions, postoperative obstruction, acute dilatation of the stomach, peritonitis, and suppuration of the abdominal wall, acute pancreatitis, perforation of gastrointestinal ulcer, appendicitis, etc.

3. Death following strangulations, toxemia from obstruction, peritonitis from ruptured and gangrenous bowel, and embolism of the mesenteric arteries.

Many of these conditions can be prevented by careful preoperative treatment, a good operative technic, and efficient after-care.

Recurrence.—In a series of cases studied by Simmons, the recurrence was lowest following the closure of the wound by transverse overlapping of the fascia. In 30 cases only 10 per cent recurred; while in 45 cases in which other methods of closure were employed, 22.2 per cent recurred. Recurrence takes place most often during the first 6 months; after a year's time it is comparatively rare, unless the wound is subjected to some severe strain, such as pregnancy, or excessive gain in weight.

Treatment

A. Congenital Umbilical Hernia of the Cord.—The treatment of congenital umbilical hernia may be either mechanical or operative.

1. *Mechanical Treatment.*—Small congenital umbilical hernias can sometimes be cured by palliative measures, which consist in keeping the parts clean and dry and using a bland dusting powder or ointment. Pressure on the tumor is maintained by wide adhesive straps passing two-thirds of the way around the abdomen. These can be most effectively applied if the child is suspended by its feet while they are put on. In this position it does not cry, there is no increase in intraabdominal tension, and the hernia is easily reduced. When the skin becomes irritated from the straps, they should be temporarily replaced by a firm binder or elastic belt.

2. *The Radical Operation.*—The operative treatment offers the best chance for a permanent cure in all patients in whom it can be used. Large hernias or eventrations, in which the viscera are irreducible and there is no chance of closing the opening, are inoperable. A few cases are on record in which the herniated liver has been successfully reduced and the opening closed. Stewart saw a case in which the liver was so firmly adherent to the fundus of the sac that reduction was impossible. Benedict reduced the spleen successfully, and several operators have found a portion of the stomach in the sac.

The earlier operation is undertaken the more chance there is for recovery. It has been successfully performed one-half hour after the child was

born. A number of successful cases are recorded in the literature in which operation was performed within two to twelve hours after birth. Alder collected 72 cases from the literature and found that when operation was undertaken in the first 24 hours the mortality was 12 per cent, while after 48 hours it was 66 per cent.

The two methods of operation are the extraperitoneal and the intraperitoneal:

1. *Extraperitoneal*.—The extraperitoneal operation is used, as a rule, because it produces less shock and gives the lower mortality. The amnion and Wharton's jelly are separated from the underlying peritoneal layer of the sac, without opening the abdominal cavity. The edges of the hernial opening are freshened on both sides, the sac folded over and sewed in place, and the muscle and skin edges brought together over it with strong sutures. The tendency of the wound to pull apart is lessened by applying firm adhesive straps around the body.

2. *Intraperitoneal Operation*.—The intraperitoneal operation is used when, for any reason, it is necessary to open the abdomen to examine the viscera or to deal with peritonitis. If there is difficulty in reducing the liver, it usually can be accomplished by incising the linea alba to widen the opening, and by dividing the round ligament of the liver.

The following method is a satisfactory one: Make a small incision one inch (2.5 cm.) long at the lower part of the hernia, and with a gauze pad in the wound to hold back the viscera, freshen the edges of the muscles and fascia and draw them together by a through-and-through suture of silkworm gut. The first incision should be prolonged one-half inch (1.25 cm.), and a second suture introduced. In this way the operation proceeds until the upper margin of the hernial opening is reached, when the sac is excised, the peritoneum closed with a running stitch, and the sutures tied. (Fig. 129.)

B. Infantile Umbilical Hernia.—The treatment of umbilical hernia in infants and children is most conveniently considered under three headings: Prophylactic measures, mechanical treatment, and the radical operation.

1. *Prophylactic Measures*.—To diminish the chance of the development of hernia, care should be exercised to avoid traction on the cord; it should be ligated one or two inches (2.5 to 5 cm.) from the abdomen, under strict aseptic precautions, and protected with sterile dressings until it separates and the granulating wound heals. An antiseptic dusting powder is often useful. The dressings can be kept free from ordinary contamination by covering the lower portion of them with collodion, oil silk, waxed paper, or adhesive tape. A snug abdominal binder should be applied and allowed to remain until the umbilical cicatrix is firm. As oftentimes umbilical hernia does not appear for a few weeks or months after birth, I have found that the binder should be left on some months longer than has been the custom—until the child is at least six months old.

2. *Mechanical Treatment.*—The mechanical treatment of small infantile umbilical hernias results in a high percentage of cures, if it is used early. A ring with a sharp distinct outline usually closes more slowly than one that is indefinite and irregular. The length of time required for cure depends largely on the age of the child, the type of truss used, and the coopera-



Fig. 129.—Intraperitoneal operation for congenital hernia of the umbilical cord. The sac is exposed, freed, opened and the contents reduced. A portion of the sac is excised and the peritoneal edges united with a running suture. The skin, muscles and fasciae are closed with interrupted sutures of silkworm gut, linen or silk.

tion of the parents in carrying out instructions. If treatment is begun at the age of one month, about two months' time is required for a cure; if the child is three to six months old, the truss will have to be worn for at least six to nine months; if treatment is not begun until the child walks, it will take a year's time, or more, to effect a cure.

The simplest treatment, and probably the best for children under a year old, is to reduce the hernia and apply a firm adhesive strap, which should reach from the posterior axillary line on one side, to the same point on the opposite side, extending at least one inch (2.5 cm.) above and one inch (2.5 cm.) below the edges of the umbilical ring. The strap should not extend entirely around the body because of the danger of an increase in intraabdominal tension, which might cause inguinal hernia.

Many of the older writers, especially the Germans, advocate the folding in of the skin and subcutaneous tissues in the form of a pad, before applying the adhesive straps. The disadvantage of this method is that the infolded skin becomes irritated, and is a source of pain and discomfort to the little patient.

The better plan is to make a pad or compress, which must always be larger than the hernial opening; this pad can be made from a large flat button or a hard rubber or cork disk, and covered with soft flannel or muslin to prevent chafing. If it is smaller than the hernial opening, it will tend to force the ring more widely open and defeat the purpose for which it is intended. With the hernia reduced, the compress is placed over the



Fig. 130.—Strip of adhesive plaster with covered button for the treatment of umbilical hernia in infants and young children.

center of the umbilicus with the convex side down, and held in position by a disk of adhesive plaster which is at least one-half inch (1.25 cm.) larger than the pad. The long adhesive straps are applied as the compress is pressed inward and the skin of the abdomen drawn in from each side. If the child is restless and crying, it is hard to adjust the straps while it is lying down, but it is a simple matter if it is suspended by its feet. In this position the hernia does not protrude, the child does not cry or kick, and intraabdominal pressure is not increased. The bandage should be changed every 1 to 4 weeks. (Fig. 130.)

After the child is one or two years old, a frame truss with a water pad is usually more satisfactory than the adhesive strapping. A bandage, belt or truss must be changed frequently to suit the growth of the child. For children under a year old, whatever appliance is used should be kept on day and night; older children should wear a truss in the day time, and a light belt at night. The skin must always be kept clean and dry. If the hernia is stationary in size or growing larger, after the child is five years old operative treatment is indicated. After this age cures by a truss are very rare, and when they are effected, there is more chance of recurrence than in those patients who were cured during the first year or two of life. It is

not unusual to see adults with recurrent umbilical hernia that was apparently cured in childhood by truss treatment.

3. *The Radical Operation.*—Operative treatment of infantile umbilical hernia is indicated when the hernia is large and causes frequent attacks of colic, vomiting, and symptoms of partial intestinal obstruction; when the hernia cannot be held satisfactorily by a truss or bandage, and when there is little prospect of cure by mechanical measures.

The Operation.—It is always possible to preserve the umbilicus and for cosmetic reasons it is inexcusable to sacrifice it, excepting in very large hernias. The incision is made either above or below the umbilicus, preferably below, in the form of a half circle, about one-third of an inch (8 mm.) from the hernia. If it is too close to the tumor, the nutrition of the flap will be interfered with. When the herniorrhaphy is combined with an abdominal operation, an incision at the side of the umbilicus is the best. The neck of the sac is now exposed, the flap turned up, and the dissection continued entirely around the sac, which is opened, and the contents reduced into the abdomen. A ligature is placed around the base of the sac, drawn tight and tied and the sac cut off. Reenforcing sutures are placed over the ligature. The separated rectus muscles are brought together and the fascia overlapped transversely, using chromicized catgut sutures. The skin wound is closed by interrupted sutures and without drainage. Long adhesive straps are applied to hold the dressings in place and take the tension off of the sutures. In a few months the cicatrix and umbilicus will be retracted and the cosmetic incision will be hardly noticeable. (Figs. 131, 132, 133, and 134.)

In the very large hernias it may be necessary to use one of the operations described under adult umbilical hernia. Montoya uses transverse overlapping of the fascia in infantile hernias and performs the operation under local anesthesia.

C. Umbilical Hernia in Adults.—Umbilical hernia in the adult is always serious, because of the difficulties of treatment, both by mechanical and operative measures. In obese subjects the amount of adipose tissue in the hernia should be reduced by a proper diet and exercise suited to their individual needs.

1. *Mechanical Treatment.*—Small umbilical hernia in subjects of average weight, can usually be controlled more or less satisfactorily by a truss of the frame type. For obese individuals with large hernias an elastic belt may be necessary.

The pad or plate that fits over the umbilical opening, should be considerably larger than the hernial ring, and made of felt; however, it can be made of metal, wood or hard rubber. It should have a deep center if the patient is obese.

The truss or belt should be applied with the patient in the reclining position. The pad should be placed a little below the center of the hernia;

this is especially important if the subject is fat and has a pendulous abdomen. When the truss is properly adjusted, it presses the hernia upward and backward when the patient is in the standing position.

Elastic belts if properly fitted will usually prevent the large hernias from increasing in size. The patient with a voluminous hernia should wear

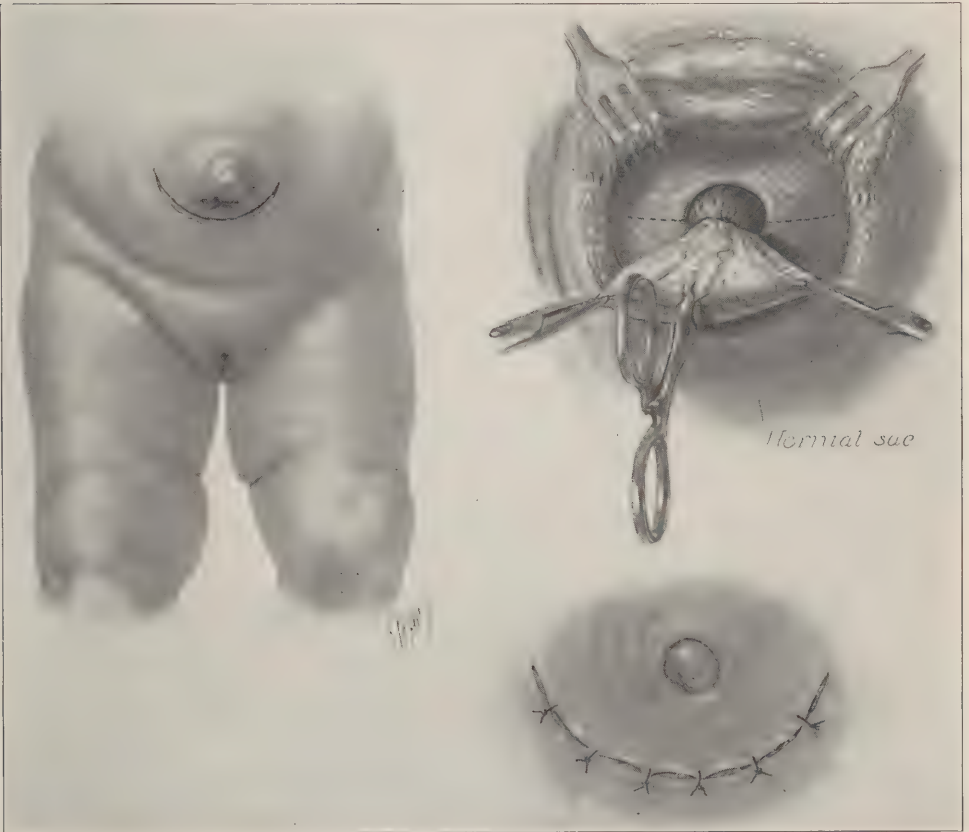


Fig. 131.

 Fig. 132.
Fig. 133.

Operation for infantile umbilical hernia.

Fig. 131.—The incision is made below the umbilicus in the form of a half circle, about $\frac{1}{8}$ of an inch (8 mm.) from the hernia.

Fig. 132.—The neck of the sac is exposed, freed, the contents reduced, and the neck of the sac ligated. If additional room is needed short incisions can be made in the inner half of each rectus muscle.

Fig. 133.—The sac is opened, excised and the rectus muscles brought together by interrupted sutures, and the fascial flaps overlapped transversely and sewn with chromic cat-gut stitches. The subcutaneous tissues are closed and the skin edges sutured together. In a few months the incision is hardly noticeable.

at night a light elastic belt that has an umbilical pad attached. (Figs. 135, 136, and 137.)

Taxis.—While taxis is seldom employed at the present time, the rules laid down by Cooper have not been improved upon: He directed that the

abdominal muscles should first be relaxed by elevating the shoulders, raising the pelvis, and bringing the thighs to a right angle with the body. The physician grasps the tumor and lifts it up to a position opposite the umbilical opening. If the hernia is small, direct pressure may be made upon it to force it into the abdominal cavity; if it is large, pressure is aided by gently kneading the neck of the sac. Often massage, with a rotary motion, over the fundus of the hernia will hasten reduction.

Other palliative measures that are useful in irreducible hernias are rest in bed, restricted diet, firm pressure over the tumor by means of a bandage, and the application of an ice bag. Some surgeons use hot applications, but I have found that if the skin is irritated or ulcerated, there is less danger of sloughing if cold applications are used.



Fig. 134.—Operation for infantile umbilical hernia. Strain is taken off the sutures by applying two adhesive straps entirely around the abdomen.

Taxis or palliative treatment of any kind must never be attempted if symptoms of strangulation are present.

For irreducible hernia I use a concave felt pad with a rim extending a little beyond the limits of the hernia. If the hernia reduces under this treatment the pad is correspondingly decreased in size. It is often most comfortable for the patient to wear an elastic belt beneath the truss. Irreducible hernias cause considerable discomfort, besides the constant danger of obstruction and strangulation, and the radical operation is always to be advised.

When the patient is very obese it is sometimes difficult or impossible to palpate a small strangulated umbilical hernia, consequently, the physician may continue palliative treatment longer than he would if he could feel a tumor to confirm his tentative diagnosis. In the presence of vomiting, con-

stipation, severe pain with or without tenderness in the umbilical region, and a history of an old umbilical hernia, it is advisable to make an exploratory incision of the hernial sac under local anesthesia to aid diagnosis.

I recall the case of a woman who became ill during the night with severe and constant pain in the epigastrium. When the attending physician called me 12 hours after the onset of symptoms, he said that she had "all the

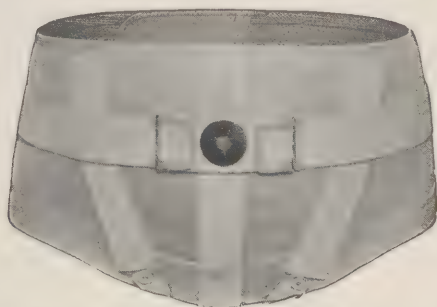


Fig. 135.—Elastic abdominal supporter fitted with umbilical hernia pad (Pomeroy).

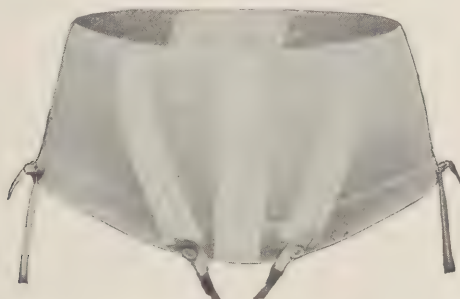


Fig. 136.—Elastic abdominal supporter for obesity (Pomeroy).

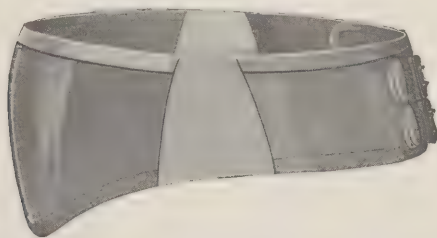


Fig. 137.—Elastic abdominal supporter (Pomeroy).

symptoms of a strangulated umbilical hernia except a tumor." I found her very obese, there was no history of hernia, and only slight tenderness over the region of the umbilicus. I made a diagnosis of strangulated umbilical hernia, and at operation under local anesthesia I found a sac the size of a hen's egg containing a knuckle of strangulated intestine.

Preoperative Treatment.—Except in strangulation, patients with irreducible hernia should be subjected to two to four weeks' preliminary treatment

to decrease the amount of fat in the hernia so that it can be reduced, and to diminish the volume of fat in the abdomen so as to provide room for the extraabdominal viscera. This precaution lessens the danger from such post-operative complications as acute dilatation of the heart, edema of the lungs, pneumonia, and renal insufficiency, which frequently follow the sudden increase in intraabdominal tension on the return to the abdominal cavity of a viscus, which perhaps has not been there for years, and has lost its *right of domicile*. Prolonged rest in bed, with or without pressure on the tumor by a binder or weight, was used by the ancients in the treatment of irreducible hernia.

The difficulties and dangers of operating on voluminous irreducible hernias as well as the chance of recurrence, are lessened if the hernia is reduced as much as possible before operation is undertaken. Many cases are recorded in the literature in which operation has been attempted on these large hernias, without preliminary treatment, and it was found impossible to return the herniated viscera into the abdominal cavity. In other instances, although it was possible to return the viscera, the tension was so great that the patient quickly succumbed, usually from acute dilatation of the heart or pulmonary edema.

Preoperative reduction of an irreducible hernia is best accomplished by rest in bed, a restricted diet or a varied diet with sufficient calories to prevent weakness, mild saline purges, and repeated gentle taxis. The use of a tightly fitting binder is better and safer than taxis, and has been strongly advocated in recent years by Hahn and McGlannan.

Arnaud, in the 18th century, wrote that the hernia should be reduced slowly, because if the procedure was too rapid the patient suffered from colicky pains. The binder should extend from the ensiform cartilage to the symphysis pubis, and to prevent abdominal contents from being forced into the sac, pads should be used on certain parts of the hernia to equalize the pressure over the entire tumor. The binder should be tightened each day, increasing the pressure as much as the patient can stand it. Sandbags will often aid reduction. Functional kidney tests will determine whether or not the patient is a safe operative risk. Unfavorable symptoms which contraindicate the operation are: Irregular or rapid heart action, changes in blood pressure, respiratory and gastrointestinal disturbances. As a rule, the weight should be reduced 20 to 50 pounds before operating. If general anesthesia is used, the amount should be as small as possible.

Postoperative Complications.—Because of the poor physical condition that is the rule in patients with massive umbilical hernia, postoperative distention, when added to the increased intraabdominal tension due to the operation, is dangerous. The disturbances in the cardiovascular system together with the embarrassed respiration, make these patients favorable subjects

for pneumonia, edema of the lungs, sudden cardiac failure, acute dilatation of the stomach, jaundice, and gastrointestinal hemorrhage.

Radical Operation.—The radical operation is always to be recommended for umbilical hernia in adults except in the presence of definite contraindications, such as advanced cardiorenal or pulmonary diseases, or when there is no prospect of reducing the hernia and closing the opening. On account of the constant danger of strangulation in large irreducible hernias, the outlook is grave, and the indications for operative relief are more urgent than in other varieties of nonstrangulated hernia. It is often difficult to sterilize the skin on account of the deep folds of the umbilicus and the frequent irritation and occasional ulceration over the fundus. The application of antiseptic dressings one or two days before operation is helpful.

The patient should be placed on the operating table in the horizontal position. (The Trendelenburg position is dangerous.) If the shoulders are

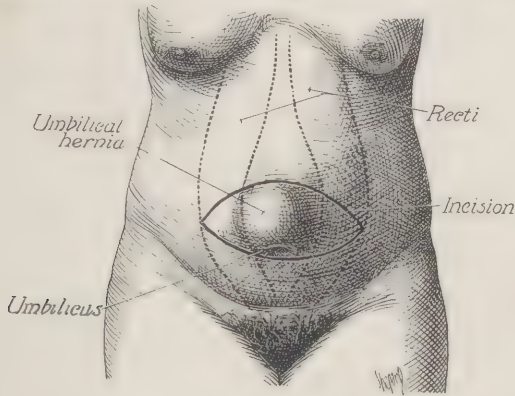


Fig. 138.—Operation for umbilical hernia in adults. An elliptical transverse incision is made below the hernia, and a second one above it, to include nearly the whole of the skin overlying the hernia. These incisions meet at the lineae semilunares (the outer border of the recti muscles). In large hernias the incisions must be longer.

slightly raised, the pelvis elevated and the thighs flexed, reduction of the contents will be facilitated and closure of the wound accomplished more easily.

Incision.—An elliptical transverse incision is made below the hernia and a second one above it, to include nearly the whole of the skin overlying the hernia. These incisions meet at the lineae semilunares (the outer borders of the recti muscles). In very large hernias or in patients with pendulous abdomens, the incisions will include not only the hernia and umbilicus, but a large amount of redundant skin and subcutaneous fat, and it may be necessary to extend the ends of the incisions beyond the lineae semilunares. The incision is now carried straight down to the aponeurosis, two to four inches (5 to 10 cm.) from the neck of the sac. (Fig. 138.)

It is easy to find the line of cleavage between the layers of fascia when the dissection is begun some distance from the umbilical ring, where the

layers are not closely adherent. The hernial mass and fat are dissected towards the umbilical ring until the neck of the sac is exposed all the way around, so that the protrusion, which is covered by undisturbed skin and fat, is attached to the abdomen only by its neck. The umbilicus may be left to facilitate approximation of the wound.



Fig. 139.—Operation for umbilical hernia in adults. The sac is opened near the neck or through the aponeurotic ring at the outer side of the sac. At this point there is small chance of encountering adhesions, and there is little danger of wounding the hernial contents.

Hemorrhage is minimized if mild traction is made on the hernial mass during the dissection, and if small blood vessels are ligated before being cut.

Sac.—The sac is opened near the neck or through the aponeurotic ring at the outer side of the sac. It is opened here, because at this point there is small chance of encountering adhesions, and little danger of wounding the

hernial contents. On account of adhesions in the sac, the viscera, especially the omentum, are liable to be wounded if the sac is opened at its fundus, and intestine is most frequently found at the upper part of the ring. (Fig. 139.)

The adhesions are separated and the hernial contents reduced into the abdominal cavity. Before this can be done, it is usually necessary to enlarge the umbilical ring, first below the neck of the sac, and if still more room is



Fig. 140.—Operation for umbilical hernia in adults. Considerable time is saved if no attempt is made to separate the omental adhesions in the sac. These large masses of fat should be ligated and cut away at the point where they emerge from the abdomen. In this way, the sac, the adherent omentum, the overlying skin and the umbilicus are cut away in one mass.

required to relieve the constriction, a second incision can be made above the sac. The point of constriction is in the fascia, which can be divided without entering the abdomen.

Omentum.—Considerable time is saved if no attempt is made to separate the omental adhesions in the sac. These large masses of fat should be ligated

and cut away at the point where they emerge from the abdomen. As much of the omentum as possible should always be removed, so as to avoid raising the intraabdominal tension any higher than necessary. The danger of embolism is lessened if the adherent omentum is ligated by multiple or interlocking ligatures of catgut, each of these including a small section of omentum from $\frac{1}{4}$ to $\frac{1}{2}$ inch (0.6 to 1.25 cm.) in width. The sac with its adherent omentum, as well as the overlying skin and umbilicus, is cut away in one mass. As the peritoneal sac is cut away, the margin is caught with hemostats and no effort is made to close the sac separately, except, perhaps, in very small hernias. (Fig. 140.)

If it is impossible to separate the intestine from portions of the sac wall, the latter can be trimmed around the adhesion and the edges united by sutures so as not to leave any raw surface exposed.

Reducing the Contents of the Sac.—If difficulty is experienced in reducing the loops of intestine after the constricting ring has been enlarged, forceps are applied to both edges of the wound and it is lifted up. A large laparotomy pad or a small towel is spread over the hernial contents and tucked in beneath the abdominal wall, entirely around the opening. The hernia is now reduced by making firm pressure on the pad with the outspread fingers of one or both hands, while an assistant applies tenaculum forceps to approximate the edges of the wound as fast as the hernia is reduced.

Resection of the Intestine Outside the Abdomen.—Resection of the intestine lying in the hernial sac is sometimes necessary in dealing with very large irreducible hernias. Only sufficient intestine should be resected to permit reduction of the sac contents, and as much of the ileum as possible should be left on account of the severe diarrhea and other metabolic disturbances that follow excision of this portion of the small intestine. Manipulation of the intestine that has lost its *right of domicile* does not produce as much shock as the handling of intraabdominal intestine. Foss, Denk, Villars and others have reported good results following the resection of the cecum, ascending colon, and portions of the ileum and transverse colon found in massive irreducible hernias.

Closure of the Umbilical Ring

1. **Transverse Overlapping of the Fascia.**—The best method of closure is by a transverse overlapping of aponeurotic flaps as first used by Mayo in 1894. A transverse incision one to three inches (2.5 to 7.5 cm.) long is made in the aponeurosis, on both sides of the umbilical ring. The flaps are freed from all overlying fat for a distance of at least two to three inches (5 to 7.5 cm.). If the hernia is small, it is usually possible to approximate the recti muscles by interrupted sutures of catgut. This step is unimportant, and usually impossible in large hernias. The fascial flaps are overlapped for two to

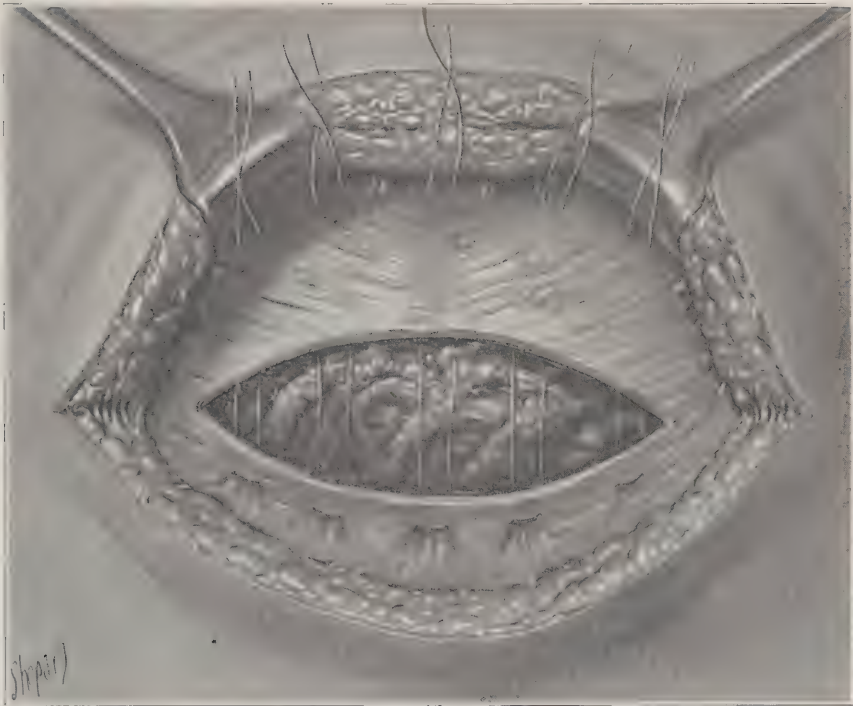


Fig. 141.—Operation for umbilical hernia in adults. Transverse overlapping of the fascia. The best method of closing the umbilical ring is by transverse overlapping for two to three inches (5 to 7.5 cm.) of aponeurotic flaps, from above downward, by interrupted mattress sutures of medium sized kangaroo tendon or of chromicized catgut (Mayo operation).



Fig. 142.—Operation for umbilical hernia in adults. The sutures are drawn tight and tied, thus pulling the entire thickness of the lower flap behind the upper flap. The free edge of the upper flap is fastened to the anterior surface of the lower flap by a continuous suture of chromicized eatgut (Mayo operation).

three inches (5 to 7.5 cm.) from above downward, by interrupted mattress sutures of medium-sized kangaroo tendon or chromicized catgut. A strong curved needle is passed from without in, through the upper flap two to three inches (5 to 7.5 cm.) from its margin, and in large hernias, it passes through the entire thickness of the aponeurosis and peritoneum, and then transversely through the whole thickness of the lower flap, about one-quarter of an inch (6 mm.) from its margin. The needle is then carried back through the hernial opening into the peritoneal cavity and made to emerge one-third of an inch (8 mm.) lateral to the point of original entrance into the upper flap. One or more additional sutures are passed on each side of this central



Fig. 143.—Operation for umbilical hernia in adults. The author's modification of the Mayo operation. Sometimes the flaps can be more accurately and firmly approximated if the lower flap is pulled through a narrow slit in the upper flap and sutured at intervals of 1 to 2 inches (2.5 to 5 cm.), instead of using mattress sutures. Finally the edge of the upper flap is sewed to the anterior surface of the lower flap by a continuous suture.

mattress suture until the opening is completely closed. After all the sutures are inserted they are tied by being drawn tight, and pulling the entire thickness of the lower flap behind the upper flap. The upper flap is now retracted, the suture line exposed, and if there is any gap, it is closed by catgut sutures, to prevent a tongue of fat or omentum slipping through. Slit-cuts in the fascia should always be sutured, otherwise they are sites of potential hernias. The lower edge of the upper flap is fastened to the outer surface of the lower flap with a continuous suture of chromicized catgut. (Figs. 141 to 142.)

The Author's Modification.—I have found that the flaps can be more accurately and firmly approximated if the lower flap is pulled through a narrow slit in the upper flap and sutured at intervals of one to two inches (2.5 to 5 cm.), instead of using the mattress sutures. The edge of the upper flap is sewed to the anterior surface of the lower flap by a continuous suture of chromicized catgut. The skin and superficial fat are closed and the patient is kept in bed twelve to twenty days. (Fig. 143.)

2. Lateral Overlapping of the Fascia.—Lateral overlapping of the fascia has been used by Blake, De Garmo, Noble, Ferguson, Bengolea, and others, but it has never become as popular as the transverse suturing. Patients with umbilical hernia usually have pendulous abdomens, which stretch the abdominal wall between the ensiform cartilage and the pubes, sometimes as much as four to ten inches (10 to 25 cm.), and the increased weight causes the spinal column to be bent backward so that the weight of the head, neck, shoulders, and upper thorax is used to counterbalance the abdomen. For this reason, overlapping from above downward is easier than the lateral method, and the more obese the patient, the easier it is to overlap the fascia transversely.

The lateral overlapping of fascia is sometimes indicated in umbilical hernia in very thin subjects. An elliptical incision is made in the long axis of the body on each side of the umbilicus. The dissection is carried down to the aponeurosis and the neck of the sac freed at the umbilical ring. An incision is made in the linea alba above and below the sac, for a distance sufficient to provide a good overlapping. The hernial sac is opened, adhesions freed, intestine reduced, and the redundant omentum and sac excised. All overlying fat is carefully dissected from the rectus sheath, and the flaps are overlapped by means of mattress sutures placed about five-eighths of an inch (1.5 cm.) apart. In applying the sutures along the edges of the inner flap and to the peritoneum, care must be exercised not to leave any raw edges. (Fig. 144.)

Other Operations.—A double-flap operation devised by Du Bose is useful when the ring is small. A transverse skin incision is made, the sac excised, and the peritoneal stump closed by a pursestring suture. Two lateral flaps of fascia are formed and slid inward, and sutured in the median line. The upper and lower flaps are then united over the lateral flaps.

A combined lateral and transverse overlapping operation is described by MacLean, who, after exposing the umbilical orifice, makes two lateral incisions from the umbilical ring to the inner border of the recti, and a third one in the fascia at the lower margin of the opening, downward to the firm lower part of the "internal ring." The lateral flaps are united and sewed to the upper margin of the "internal ring." The upper flap is then drawn downward and fastened to the aponeurosis, covering the united lateral flaps.

Pringle unites the recti, the posterior layer of fascia, and the peritoneum by mattress sutures, then closes the anterior layer of aponeurosis by

transverse overlapping. The operations which have been used for umbilical hernia are numerous, and the ingenuity of the individual surgeon leads to a continual improvement in the details of technic.

(Previous to the adoption of the method of closing the wound by flaps of fascia, numerous methods of operative treatment were employed, but as

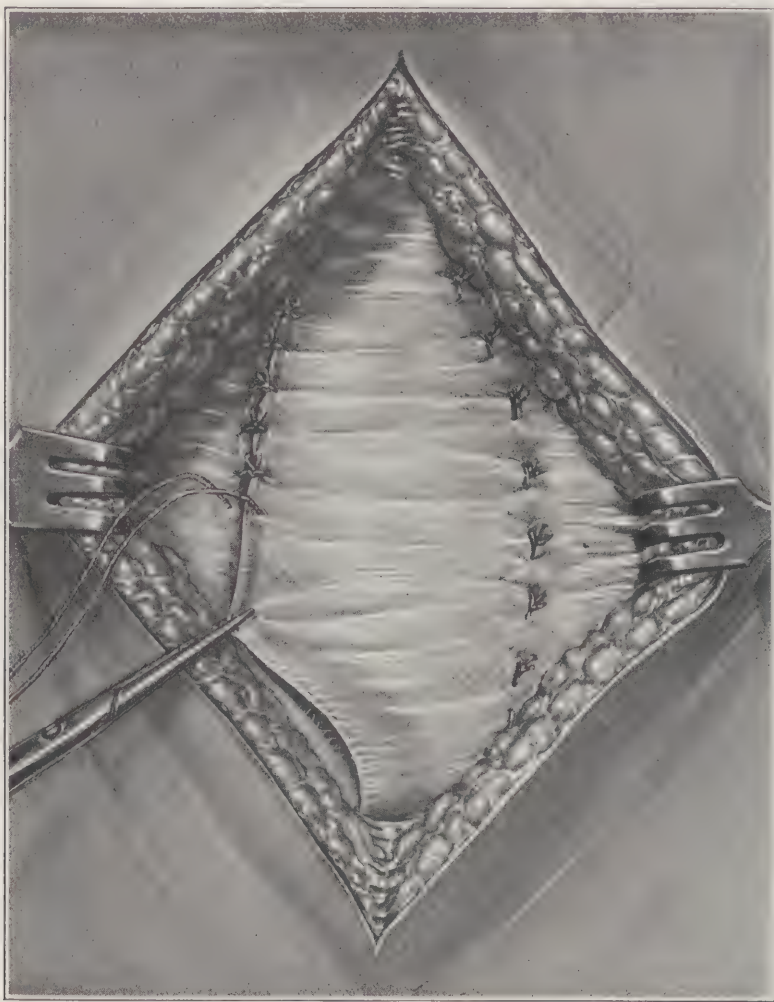


Fig. 144.—Operation for umbilical hernia in adults. Lateral overlapping of the fascia.

none of them show results that in any way compare with those secured by the use of fascial flaps, space will not permit a description of them.)

Wire Filigree.—The wire filigree acts as a foreign body in the tissues and should be used only in exceptional cases. I believe any defect that can be covered with a filigree can be more effectively closed by a free transplantation of fascia.

Closure of Subcutaneous Tissues and Skin.—The thick layer of subcutaneous fat must be carefully closed by one or two layers of running sutures. Care should be exercised to avoid leaving any “dead spaces” where blood or serum may collect. As a rule, drainage should be avoided, as in all clean hernia operations primary union is more prompt without it. However, when drainage is required, I prefer a stab-drain made below or to one side of the skin closure, and a wick of soft rubber or gutta percha tissue inserted. A fluffed gauze dressing is applied and held in place by adhesive straps passing around the body, or by a Scultetus bandage.

Postoperative Treatment.—The patient should be carefully watched for circulatory or respiratory complications. Obese patients should have their shoulders elevated while in bed to prevent pulmonary complications and hic-cough. They should be allowed to sit up in bed a few days after operation. The stomach should be washed out frequently during the first 24 hours to prevent distention. Large doses of alkalies and glucose should be administered to prevent acidosis. To combat gas pains, the patient should be allowed to roll from side to side, and abdominal massage should be used at half-hour intervals when possible. The patient is got out of bed as soon as advisable, usually within twelve to twenty days.

He should wear a snugly fitting elastic belt for a year or longer; and he must be warned of the danger of recurrence and instructed to avoid a gain in weight. He should not undertake any exercise or work that will put a strain on the wound.

Mortality Rate Following Operation for Non-strangulated Umbilical Hernia.—In the 600 operations for non-strangulated umbilical hernia that I collected from the literature, there were 9 deaths (1.5 per cent).

Lipectomy.—More or less fat is always removed during the course of an operation for umbilical hernia in adults. The wide excision of fatty flaps, in the pendulous abdomens associated with umbilical hernias, is to be recommended.

Indications for Lipectomy.—A pendulous abdomen associated with the following symptoms calls for a lipectomy: A continuous heavy dragging sensation over the stomach, backache and intestinal disturbances which are due to an elongated mesentery.

Operation.—The removal of a wedge-shaped section of fat gives better access to the umbilical ring, facilitates the suturing, and lessens the tendency to recurrence. The vertical width which is to be removed is ascertained by lifting up the abdominal wall until the pendulous suprapubic fold of tissue disappears.

The best incision for lipectomy, from a cosmetic standpoint, is a vertical one. With the transverse incision, unless the fat is carefully trimmed, there will be unsightly horn-like projections at each end of the incision. There is no reaccumulation of fat if the patient watches his diet, and his personal comfort as well as his appearance, is very much improved. (Fig. 145.)

Strangulated Umbilical Hernia in Adults.—The majority of umbilical hernias are irreducible and the patient is accustomed to considerable pain, discomfort, and occasional attacks of partial obstruction, so that when strangulation does occur, it is often not recognized until the most favorable time for operation has passed. The strangulation is frequently intrasaccular and is often due to omental adhesions in the sac. On account of the enfeebled physical condition of these patients, who are usually advanced in age or have fatty hearts and arteriosclerosis, discretion must be used in the extent of the operation to which they are subjected. As a rule, the safest plan is merely to relieve the strangulation under local anesthesia, and leave the radical operation for a future time, when the patient is in a better condition.

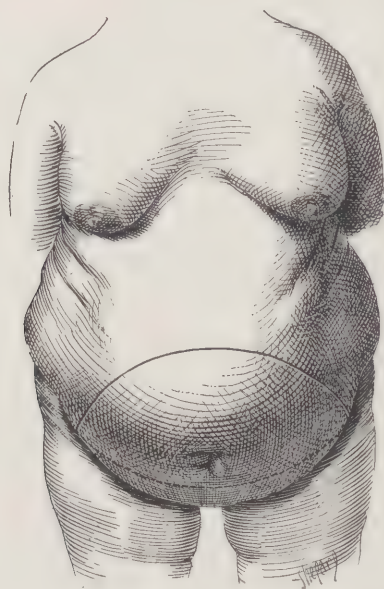


Fig. 145.—The operation for umbilical hernia combined with lipectomy in adults. In patients with pendulous abdomens, the removal of a wedge-shaped section of fat gives better access to the umbilical ring, facilitates the suturing, and lessens the danger of recurrence.

The mortality of strangulated umbilical hernia has been very high (10 to 50 per cent). In 55 cases collected from the literature by Vulpius, there were 9 deaths. Several factors are responsible for this high rate: Difficulty in diagnosis, delayed operation, the use of general anesthesia, and the attempt to complete the radical operation when the patient's condition does not warrant it.

The best and quickest method of dealing with strangulated hernia by the one-stage operation, is to open the neck of the sac at the side and complete the circular incision of the sac with scissors; in this way the fibrous ring is removed with the sac. The hernial sac is now opened from the inside with scissors, and the contents dealt with as their condition demands.

Bibliography

UMBILICAL HERNIA

- AARON, C. D.: Umbilical dyspepsia. J. Am. M. Assn., Chi., 1916, lxvi, 1534-1535.
- AHLFELD, F.: Die Entstehung des Nabelschnurbruchs und der Blasenspalte. Arch. f. Gynæk., Berl., 1877, xi, 85-109.
- ALDER, G.: Ueber Nabelschnurbrüche. I. D., Zurich, 1904.
- ARNAUD, G.: A dissertation on hernias or ruptures. London, A. Millar, 1748, p. 147-154.
- AVICENNA: Liber canonis, de medicinis cordialibus, et cantica. Venetiis, Iuntas, 1555, p. 399.
- BENEDICT, S. C.: An enormous congenital umbilical hernia without cutaneous covering; operation; recovery. Med. Rec., N. Y., 1892, xli, 263-264.
- BENGOLEA, A. J.: Una nueva técnica para la cura radical de las hernias umbilicales en el adulto. Prensa méd. argentina, Buenos Aires, 1917-1918, iv, 365.
- BÉRARD, L.: See Jaboulay M. et Patel, M.: p. 246.
- BLAKE, J. A.: The operative treatment of umbilical hernia in adults. Med. Rec., N. Y., 1901, lix, 803-807.
- BUFORD, C. G.: Umbilical hernia of infants and children. Surg. Clin., Chi., 1918, ii, 633-640.
- BUSCHAN, G.: Ueber Hernia funiculi umbilicalis. I. D., Breslau, Lindner, 1887.
- CELSUS, A. C.: De arte medica, editi G. P. Tiletani. Basileæ, per Ioannem Oporinum, 1552, p. 519-521.
- CELSUS, A. C.: Of Medicine. English transl. by J. Grieve, Lond., D. Wilson & T. Durham, 1756, 418-420; 432-435.
- COLEY, W. B., AND HOGUET, J. P.: Operative treatment of hernia. Ann. Surg., Phila., 1918, lxxviii, 255-268.
- CONDAMIN, R.: De l'omphalectomie et de la suture à trois étages dans la cure radicale de hernies ombilicales; étude de indications et de quelques procédés opératoires récents. Arch. prov. de chir., Par., 1892, i, 193-221.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key. London, Longman, Rees, Orme, Brown & Green, 1827.
- CRUVEILHIER, J.: Traité d'anatomie pathologique. Paris, Baillière, 1849, i, 628-630.
- DAURIAC, J.: Procédé nouveau pour la cure radicale de la hernie ombilicale (procédé de l'entrecroisement des droits). Gaz. d. hôp., Par., 1894, lxxvii, 675-676.
- DE GARMO, W. B.: The treatment of umbilical hernia. Internat. J. Surg., N. Y., 1899, xii, 95-98.
- DE GARMO, W. B.: Abdominal hernia. N. Y. & Phil., Lippincott, 1907.
- DELATOUR, H. B.: Relief of umbilical hernia by the Condamin-Ransohoff technic. Ann. Surg., Phila., 1918, lxxvii, 732-733.
- DENK, W.: Zur Operativen Behandlung der Hernia permagna irreponibilis. Deutsche Ztschr. f. Chir., Leipz., 1922, clxxvi, 399-401.
- DU BOSE, F. G.: A new operation for umbilical hernia. Surg. Gynec. & Obst., Chi., 1915, xxi, 771-773.
- FERGUSON, A. H.: Modern operations for hernia. Chicago, Cleveland Press, 1907.
- FINSTERER, J.: Ein Beitrag zur Kasuistik und Therapie des Nabelschnurbrüches. Wien. klin. Wehnschr., 1906, xix, 795-800.
- FOSS, H. L.: Intestinal resection in massive umbilical hernia. Surg., Gynec. & Obst., Chi., 1923, xxxvi, 263-270.
- DE GARENGEOT, R. J. C.: Traité des opérations de chirurgie. 2nd ed. Paris, Huart, 1731, i, 356-366.
- GOLDSPOHN, A.: Large ventral and umbilical herniae in the adult, with three cases of radical cure by an improved technique. Am. Gynec. & Obst. J., N. Y., 1897, xi, 301-320.
- GRASER, E.: Hernia. In: A system of practical surgery. Bergmann-Bruns-Mikulicz. English transl. ed. by W. T. Bull. N. Y. & Phila., Lea Bros., 1904, iv, 532.
- GRASER, M. E.: Contribution à la cure radicale des grosses hernies ventrales et ombilicales; technique de Pfannenstiel-Menge. Rev. de gynéc. et de chir. abd., Par., 1906, x, 930-933.
- GUY DE CHAULIAC: Arte medica exercitissimi chirurgia. Lugduni, Sebastianum Honoratum, 1622, p. 410-412.
- HAHN, J.: Die radical Operation der Ueberhernien mit Hülfe der systematischen Dehnung der Bauchdecken. Arch. f. klin. Chir., Berl., 1908, lxxxv, 718-741.
- HARTMANN, H.: La suture par doublement dans la cure des éventrations larges et des grosses hernies ombilicales. Compt. rend. Soc. d'obst., de gynéc. et de pædiat. de Par., 1904, vi, 83-91.

- HEISTER, D. L.: *Institutiones chirurgicæ*. Amsterdami, J. Waelbergios, 1747, ii, 734-747.
- HERTZFELD, M.: Ein fall von Nabelschnurbruch. I. D., Königsberg, 1892.
- JABOULAY, M., AND PATEL, M.: Hernies. xxv. *Nouveau traité de chirurgie*. Le Dentu, A., et Delbét, P., Paris, Baillière, 1908.
- JOHNSON, J. T.: Ruptured umbilical hernia. Tr. South. Surg. and Gynec. Assn., 1901, xiv, 257-268.
- KEEN, W. W.: Omphalectomy for strangulated umbilical hernia; death. Med. News, Phila., 1888, lii, 205-207.
- KELLY, H. A.: An operation for umbilical hernia. Ann. Surg., Phila., 1910, li, 694-696.
- LUCAS-CHAMPIONNIÈRE, J.: La hernie ombilicale. Thérapeutique et cure radicale. Sur 18 cas de hernie ombilicale et 11 cas de hernie épigastrique traitée par la cure radicale. J. de méd. et de chir. prat., Par., 1895, lxvi, 609-633.
- LUDINGTON, N. A.: Umbilical hernia. Proc. Connect. M. Soc., N. Haven, 1919, exxvii, 67-81.
- MACDONALD, W. G.: A case of congenital umbilical hernia; abdominal section six hours after delivery; recovery. Am. J. Obst., N. Y., 1890, xxiii, 7-13.
- MCGLANNAN, A.: Massive umbilical and ventral hernias. Surg. Gynec. & Obst., Chi., 1915, xx, 700-704.
- MCGRATH, W. J.: Unusual case of umbilical hernia; rupture of skin. J. Am. M. Assn., Chi., 1918, lxxi, 1650.
- MACLEAN, N. J.: The extreme pendulous abdomen and its surgical treatment by a new three-flap operation. Surg. Gynec. & Obst., Chi., 1919, xxviii, 190-194.
- MACREADY, J. F. C. H.: A treatise on ruptures. Lond., C. Griffin & Co., 1893.
- MALGAIGNE, J. F.: Leçons cliniques sur les hernies. Par., Germer-Baillière, 1841, p. 231-232.
- MAYO, W. J.: Remarks on the radical cure of hernia. Ann. Surg., Phila., 1899, xxix, 51-61.
- MAYO, W. J.: Further experience with the vertical overlapping operation for the radical cure of umbilical hernia. J. Am. M. Assn., Chi., 1903, xli, 225-228.
- MICHAEL, J. E.: Report of a case of ventral hernia successfully treated by operation, with a suggestion as to the method of operating. Tr. Am. Surg. Assn., Phila., 1887, v, 227-230.
- MONTOYA, J. M.: Hernia umbilical. Repert. de med. y cirug., Bogota, 1918-19, x, 338-347.
- MOSCHCOWITZ, A. V.: The pathogenesis of umbilical hernia. Ann. Surg., Phila., 1915, lxi, 570-581.
- NICAISE, E.: Ombilie. Paris, 1881. (Reprint Dict. et encycloped. d. sc. méd., Par., 1880, 2 s., xiv.)
- NIWASE, N.: Position of the navel of man. Am. J. Obst., N. Y., 1919, lxxx, 49-52.
- NOBLE, C. P.: Overlapping the aponeuroses in the closure of wounds of the abdominal wall—including umbilical, ventral and inguinal herniæ. Ann. Surg., Phila., 1906, xliii, 349-358.
- PARÉ, A.: Les oeuvres. Paris, G. Buon, 1579, p. 297-306.
- PAULUS ÆGINETA: The seven books of, English transl. by F. Adams, London, the Sydenham Society, 1846, ii, 372-374.
- PETIT, J. L.: Oeuvres complètes. Limoges, F. Chapouland, 1837, p. 666-679.
- PFANNENSTIEL, J.: Ueber die Vortheile des suprasymphysären Fascienquerschnitt für die gynäkologischen Kōliotomien zugleich ein Beitrag zu der Indikationsstellung der Operationswege. Samml. klin. Vortr., n. f., Leipzig., 1900, p. 1735-1756.
- PICCOLI, E.: Zur Radikalbehandlung der Nabelhernien. Centralbl. f. Chir., Leipzig., 1900, xxvii, 36-38.
- POTT, P.: A treatise on ruptures. London, Hitch & Hawes, 1756.
- PRINGLE, J. H.: A method of treating umbilical hernia. Edinb. M. J., 1913, n. s., x, 493-496.
- QUÉNU, E.: La cure radicale de la hernie ombilicale. Gaz. méd. de Par., 1893, 8 s., ii, 605-607.
- RANSOHOFF, J.: The radical cure of umbilical hernia by omphalectomy. Med. Rec., N. Y., 1897, li, 150-152.
- RUBEN, M.: A case of subserous lipoma of the colon transversum incarcerated in the sac of an umbilical hernia. Acta. Chir. Scand., Stockholm, 1920-1921, liii, 339-353.
- RUYSCH, F.: Observationum anatomico-chirurgicarum. Amstelodami, Henricum et Viduam T. Boom, 1691, p. 92.
- SAINT HILAIRE, G.: See Dubois, P.: Deux cas de monstruosité. Mém. Acad. de méd. de Par., 1835, iv, 475-488.
- SAPIEJKO, K.: Un nouveau procédé de cure radicale des grandes hernies ombilicales avec diastase des muscles grands droits. Rev. de chir., Par., 1900, xxi, 241-261.
- SAVIARD, B.: Nouveau recueil d'observations chirurgicales. Paris, J. Collombat, 1702.

- SCARPA, A.: Sull'ernia memorie anatomico-chirurgiche. 2nd ed., Pavia, Dalla stamperia Fusi e co. success. Galeazzi, 1819.
- SIMMONS, C. C.: The end-results in 70 consecutive cases of umbilical hernia operated on at the Massachusetts General Hospital. Boston M. & S. J., 1916, clxxiv, 342-345.
- STEWART, G. C.: Hernia of the umbilical cord. Brit. M. J., Lond., 1905, i, 247.
- STORER, H. B.: A new operation for umbilical hernia. Med. Rec., N. Y., 1866-1867, i, 73-76.
- SURET: D'un nouveau bandage pour l'exomphale. Mém. Acad. roy. de chir., Par., 1787, v, 364-368.
- TROUSSEAU: D'un nouvel appareil pour le traitement des hernies ombilicales chez les enfants à la mamelle. Gaz. d. hôp., Par., 1844, 2 s., vi, 309.
- VILLARS, H. S.: Massive ventral hernia with fecal fistula. Ann. Surg., Phila., 1923, lxxvii, 445-449.
- VULPIUS, O.: Die Radikaloperation der Hernien in der vorderen Bauchwand. Beitr. z. klin. Chir., Tübing., 1891, vii, 91-134.
- WARREN, J. C.: The operative treatment of umbilical hernia. Boston M. & S. J., 1903, cxlix, 400-404.
- WILLIAMS, A. H.: Rupture of ulcerated abdominal wall over an umbilical hernia, with protrusion of gut, untreated for seven and a half hours; uninterrupted recovery. Brit. M. J., London., 1907, i, 684.
- WOOD, J.: On rupture. Lond., J. W. Davies, 1863, p. 251-257.

CHAPTER XVI

VENTRAL HERNIA

Definition.—Ventral hernia is a protrusion through the anterior abdominal wall, occurring at points other than the inguinal, femoral or umbilical openings.

From an etiologic standpoint, ventral hernias are customarily divided into two varieties: Spontaneous or acquired, and traumatic or incisional. There are several types of the spontaneous variety: Hernia in the linea alba, hernia in the linea semilunaris, hernia in the linea transversa, and hernia in the sheath of the rectus muscle. Spontaneous hernia may rarely occur in the space bounded by the posterior border of the external oblique muscle behind, the false ribs above, and the iliac crest below. The traumatic or incisional hernias may appear anywhere in the median or lateral abdominal wall.

From a surgical point of view, it is most satisfactory to consider ventral hernia under the following headings: 1. Hernia in the linea alba, which is the most important of the spontaneous hernias; 2. Lateral ventral hernias, which include all of the spontaneous hernias occurring in the lateral abdominal wall, as well as those of the traumatic or incisional types.

The term “epigastric hernia” is restricted to those hernias appearing in the epigastric region. Hernias in the linea alba appear below the umbilicus as well as above it, and for this reason it is most convenient to consider them under the name of *Hernias in the Linea Alba*. (Fig. 146.)

Historical.—In ancient times no distinction was made between ventral and umbilical hernias. In the 14th century Guy de Chauliac attempted to distinguish those hernias coming through outside the umbilicus from those protruding through the umbilical opening, but his efforts received scant notice. La Chausse, in 1721, maintained that hernia could come through any part of the abdominal wall. De Garengot, in 1743, described ventral hernia, and Platner, writing in 1747, believed that the hernia separated the muscles and came through between them. Richter, in 1785, stated that the hernia came through the umbilical ring in infants, and to one side of the ring in adults.

In 1737 Petit stated that only 2 per cent of umbilical hernias came through the ring, and Scarpa agreed that the condition was very rare; on the other hand, Cooper, Cruveilhier, and Velpeau maintained that a majority of these hernias came through the umbilical opening.



Fig. 146.—The surface anatomy of the anterior abdominal wall. Showing the umbilicus, the linea alba, the lineae semilunares and the inguinal and femoral regions.

On account of the frequency of gastrointestinal symptoms accompanying epigastric hernia, De Garengéot, Hoin, Pipelet, and others, writing in the 18th century, believed that the stomach was always in the hernia, while Günz believed it was present only in rare instances. Cooper dissected two cases of strangulated epigastric hernia, and in both only colon was found. During the last century, it has been generally agreed that the gastric symptoms are due to traction of a portion of the great omentum which is adherent in the sac, or to the dragging of the falciform or round ligament of the liver on the peritoneum or properitoneal fat. Lévillé, in 1812, applied the term *epigastric* to those hernias occurring in the median line above the umbilicus.

HERNIA IN THE LINEA ALBA

Synonyms.—Epigastric hernia; Gastrocele; Sepoy's hernia; Hypogastric hernia; Hernia ventralis mediana.

Definition.—A hernia in the linea alba is a protrusion of abdominal viscera through an opening in the linea alba.

Hernia in the linea alba usually occurs above the umbilicus, when it is known as epigastric hernia, because in olden times it was believed to be a hernia of the stomach.

Anatomy

The Linea Alba.—The linea alba extends from the ensiform cartilage to the symphysis pubis. It is situated between the inner borders of the recti muscles, and is formed by the blending of the aponeuroses of the external and internal oblique and the transversalis muscles. It is narrow after the first one or two inches (2.5 to 5 cm.) below the umbilicus, where the recti muscles are well developed and close together. Above the umbilicus the muscles become thinner and tend to separate as they pass upward to their insertions in the costal cartilages of the fifth, sixth and seventh ribs. Only a few fibers go to the ensiform cartilage. As the linea alba approaches the ensiform cartilage it is often one-half to one inch (1.25 to 2.5 cm.) wide, and is connected with the lineae semilunares by the lineae transversae, which are narrow tendinous bands intersecting the recti muscles. The falciform ligament of the liver is attached to the diaphragm and to the linea alba, usually a little to the right of the midline. This ligament consists of two layers of peritoneum enclosing a mass of fatty tissue, which is closely adherent to the posterior surface of the linea alba. The free border of the ligament, which extends from the umbilicus to the anterior border of the liver, contains the round ligament between its layers.

There are minute openings in the linea alba, usually five on each side, for the passage of vessels and nerves. When the vessels pierce the transversalis fascia they carry a prolongation of this fascia with them and this

opening is a weak point in the linea alba. With an increase of intraabdominal pressure the first tissue to be forced through is the properitoneal fat of the falciform ligament. In 13 cases of hernia in the linea alba observed by Barthélemy, the falciform ligament was usually adherent to the opening.

The aponeurotic fibers interlace from each side, and transverse slit-like openings are frequently left in the fascia. These openings, at first quadrilateral or elliptical in shape, become oval under long pressure. They are more frequently found in adults than in children.

The Hernial Orifice.—When hernia in the linea alba does not involve the falciform ligament, the opening is usually to the left of the median line or



Fig. 147.—Hernia in the linea alba. Small epigastric hernia in a man, aged 35.

it may rarely be in the center. On the other hand, if the hernia contains only properitoneal fat of the falciform ligament, the opening is almost always just to the right of the median line. It is most often found within the first three inches (7.5 cm.) above the umbilicus; less frequently it is within the first two inches (5 cm.) below the umbilicus. These hernias are rare in the upper or lower portions of the linea alba. Occasionally there may be more than one opening. Berger saw 4 in one patient, and Bainbridge observed a patient with umbilical hernia, who also had four openings in the linea alba. I have seen three openings below the umbilicus in an elderly woman.

Size of the Hernial Opening.—The hernial opening is ordinarily no larger than the tip of the little finger, and there is not much tendency for the small hernias to increase in size because the fascia is strong and unyield-

ing. Large hernias in the linea alba are almost always found just above the umbilicus. (Figs. 147 and 148.) Sultan observed a hernia the size of a man's head. Phillips reported a hernia in the linea alba in a man, 70 years of age. It protruded three inches (7.5 cm.) beyond the abdominal wall and the ring measured four and one-half inches (11.25 cm.) across; the hernia had been present for many years and had caused no symptoms.



Fig. 148.—Hernia in the linea alba. Large hernias in the linea alba are almost always found above the umbilicus.

The Hernial Sac.—Small hernias in the linea alba are usually without a sac. In 67 cases reported by Naegeli, 61.2 per cent presented a properitoneal lipoma without a sac; in the remaining 38.8 per cent a sac was found.

When a sac exists, it may be very small, barely protruding through the opening in the fascia, and often it is not discovered until the properitoneal lipoma is excised.

The Hernial Contents.—A mass of fat or a properitoneal lipoma is often the sole content of the small hernias. L  veill  , in 1812, remarked that these hernias usually consisted of a small lipomatous mass, rarely of omentum.

In large hernias, the sac usually contains omentum, sometimes transverse colon and small intestine, and rarely ascending or descending colon, stomach, gall-bladder or other viscera. These large hernias usually have a pedicle, and the neck of the sac is seldom adherent to the edge of the fibrous ring. As in the umbilical variety, the omentum in large hernias in the linea alba becomes adherent to the sac wall early, and for this reason many of these hernias are irreducible. LePage found omental adhesions in the sac in 17 out of 19 cases. Rarely the umbilical vein may be the sole content, as in the case reported by Leboeuf. Vialle found the gall-bladder adherent in the sac. Part of the stomach wall has been found in the sac by Hedlund, Brandi, Mantelli, Pregaldino, Denk, and others, but it is rare. Strangulation very seldom occurs.

The following table gives a good idea of the relative frequency of the most common hernial contents:

	TOTAL CASES	FAT ALONE	PERITONEAL SAC ALONE	OMENTUM ONLY	INTESTINE
Thoman	38	6	2	26	4
Ploeger	86	39	11	31	5

Diastasis of the Recti

1. In Children.—In young children sometimes the linea alba is very thin and abnormally wide, so that there is a separation of the recti muscles and a bulging is noticed when the child cries. The protrusion is usually above the umbilicus, when it is known as a supraumbilical eventration, or it may sometimes appear just below the navel. Macready reported the case of a boy, two years old, with a diastasis of the recti extending from the ensiform to the pubes. This condition is of equal frequency in both sexes, and as the child grows the muscles gradually come together.

2. In Adults.—In adults the diastasis may occur anywhere in the linea alba. It usually appears below the umbilicus, and in rare instances, it may extend from the umbilicus to the pubes. It is most common in women, often being caused by repeated pregnancies.

Large eventrations may reach below the pubes and contain all the movable abdominal viscera, and the uterus during pregnancy. The margins of the separated recti can be felt on each side of the tumor. The symptoms are those accompanying any large hernia, pain, constipation and marked disability. Mechanical treatment is usually unsatisfactory. The radical operation described for ventral hernia is the treatment of choice, and it should be undertaken early, on account of the atrophy of the muscles in the neglected cases.

Herold reported an interesting case of separation of the recti and dia-

phragmatic hernia in a man 22 years old. The umbilicus was higher than normal, and just above the navel in the median line was an irregular area as large as the hand, that was covered only by skin, which was of a dark hue. The apex of the heart and the interventricular groove could be palpated easily; pressure on the heart would cause it to skip a beat. The edge of the liver could also be felt. The patient had been accustomed to wearing a belt to hold the mass in the abdomen. Kirmisson saw a hernia of this variety in an infant; and Lannelongue observed one in a woman aged 20.

Suprapubic Hernia in the Linea Alba.—Voekler, in 1912, called attention to a rare form of hernia in the linea alba to which he applied the term, *suprapubic hernia*. He reported a case occurring in a woman, 44 years old, who complained of a localized point of tenderness and a tumor the size of a pigeon's egg just above the symphysis pubis in the midline. Symptoms of strangulation developed and operation disclosed a hernia, the size of a pear, extending over the symphysis pubis into the labium majus. Gangrenous intestine was resected, the sac excised, and the peritoneum, fascia and pyramidalis muscles were sutured together in separate layers; the patient made an uneventful recovery. Voekler was able to collect 5 additional cases in the literature.

In 1917, Forshaw reported a case in a woman, 41 years of age. At operation the sac was found firmly "nipped" by the recti muscles. The constriction was divided above toward the umbilicus to avoid injury to the bladder. Neild reported another case, in which the whole hand could be introduced through the opening and the pelvis explored.

Varieties of Hernia in the Linea Alba.—Terrier proposed classifying hernias in the linea alba as follows:

1. Lipomas without a peritoneal sac.
2. Lipomas with a peritoneal sac containing omentum.
3. Omental hernia without a lipoma.
4. Peritoneal sacs containing intestine and omentum.

Etiology

Hernia in the linea alba is more frequent than statistics indicate. Patients with this variety of hernia usually have no symptoms, and doubtless many of them never seek medical advice. In the examination of recruits, Hall stated that these hernias were found "by the dozen"; that they were so common no record was made of them except when they were accompanied by symptoms. In 28,348 hernias collected by Sebba, 223 or .8 per cent were in the linea alba. In 7,500 patients examined in a medical clinic and reported by Phillips, 42, or 0.56 per cent had hernia in the linea alba, and in 3,000 clinic patients reported by Evely, it was found in 15, or 0.5 per cent.

In 15,271 clinical cases collected from the literature by Friedrich, the frequency of hernia in the linea alba was as follows:

	PATIENTS EXAMINED	CASES OF HERNIA IN LINEA ALBA	PER CENT
Males	12,724	52	.41
Females	2,557	2	.08

The older statistics indicate that hernia in the linea alba constitutes about 1 per cent of all hernias, and that it occurs five times more often in men than in women. In 10,000 hernias collected by Berger, 137 were in the linea alba, and of these 120 occurred in men. In 21,812 hernias collected by Macready, 38 were in the linea alba, and of these 30 were in men. In 44 cases of hernia collected by Roth, 66 per cent were in males.

These hernias develop earlier in men than in women and are most common between the twentieth and thirtieth years. In a series of 71 cases reported by Nageli, 94.4 per cent were in men, and 5.6 per cent in women. In the women, 33.8 per cent occurred between the twentieth and thirtieth years and 22.5 per cent between the thirtieth and fortieth years. In young children the sexes are affected equally, but the condition is rare. These hernias are often associated with hernias of other regions, in both children and adults. Malgaigne found that in 18 cases of hernia in the linea alba, 14 were associated with hernias of other varieties.

Predisposing Causes

1. **Congenital.**—There is probably no congenital predisposition to hernia in the linea alba. Congenital weakness of the linea alba, malformation or arrested development of the muscles or fascia may be a favoring factor. Cooper saw an infant with three hernias in the linea alba that were present at birth; LePage and Walter each observed a similar case. I saw an infant, one year old, with an epigastric hernia of congenital origin that measured 1 inch (2.5 cm.).

2. **Properitoneal Lipoma.**—The importance of properitoneal lipoma in the etiology of hernia in the linea alba, was recognized by many of the early writers, including Scarpa, Cooper, Cloquet, Velpeau, and others. It is probable that a small lobule of fat, aided by intraabdominal pressure insinuates itself into an interstice in the fascia, and as it increases in size, it acts as a wedge gradually spreading the elliptical opening. As this fatty plug advances, it draws after it a funnel-shaped process of parietal peritoneum, which is usually empty and is not discovered until the lipoma is cut away.

Many writers believe that these hernias escape through an opening in the fascia alongside the blood vessel. This point was emphasized by Cooper, who stated that "these holes are sometimes larger than is sufficient to allow the vessels to pass, and protrusions of viscera readily occur through them." I have never failed to find a well-defined vessel coming through the opening in the fascia, accompanied by a lipoma which is continuous with the fat

of the falciform ligament. Villard maintained that epigastric hernias are sliding hernias of the round ligament of the liver.

3. **Exciting Causes.**—Other factors that favor the development of hernia in the linea alba are strains, laborious occupations, and traumatic injuries. These hernias usually occur in men who do heavy manual labor; in women, pregnancy is the principal exciting cause. Obesity and rapid emaciation have their influence in both sexes.

Symptoms and Diagnosis

Recent examinations of recruits for the Army and Navy show that hernia in the linea alba is more frequent than statistics have indicated. It is a subject that has always been overlooked more than neglected. The tumor is almost always small; there are no symptoms in 75 per cent of the cases, and diagnosis depends on a thorough and painstaking examination.

Small hernias in the linea alba may also give rise to very severe symptoms. Unless the possibility of hernia is always borne in mind, diagnosis may be difficult on account of the prominence of the gastrointestinal symptoms.

Functional Symptoms.—The subjective symptoms include colicky pain, nausea, sour stomach, distress after eating, occasional vomiting, constipation, and a dragging sensation in the abdomen, which is due to traction on the parietal peritoneum or on the falciform ligament. Villard believed that the unusual functional symptoms may also be due to traction exerted by the round ligament on the liver.

The pain is most severe in the epigastrium and sometimes extends to the thorax, the lateral abdominal wall, lumbar region, bladder and rectum. Blumer had a patient who complained of pain radiating to the shoulders and arms, and Aaron's patient had paroxysms of pain after eating, which sometimes extended around the body and down the thighs.

Patients sometimes secure temporary relief from the pain by vomiting, or taking a small quantity of liquid food, or by lying on the back. The pain is aggravated by coughing, physical exercise, and by eating solid food. Brandenburg stated that the first symptom of hernia in the linea alba in children is usually pain in the abdomen after meals, especially after breakfast.

Objective Signs.—The objective signs are often indefinite: A small tumor, sometimes no larger than the tip of the little finger, should be looked for just above the umbilicus to the left of the median line; or it may be found, in rare instances, in the center or just to the right of the median line. While it is unusual, the hernia occasionally appears below the umbilicus, and the suprapubic variety makes its appearance just above the symphysis pubis in the median line.

Owing to the severity of the functional symptoms, which overshadow the objective signs, the existence of a small tumor may not be thought of.

and it may be discovered quite accidentally during a close examination of the abdomen. The relief of symptoms that follow the reduction of this little tumor, may give the first clue to diagnosis. The most characteristic objective sign is localized pain and tenderness on pressure over the hernia. In obese subjects a small hernia may be impalpable, but a definite point of tenderness can always be located. If the hernia is reducible it disappears when the patient is in the reclining position, and the sharp edge of the ring can be felt by making pressure on the tumor and following it with the finger through the opening, as it is reduced. Small openings in the fascia that cannot be felt when the hernia is reduced can be detected by this maneuver. Light pressure on the hernia is sometimes followed by instantaneous belching. Hall has termed this sign the "electric-bell reaction."

Coley has called attention to the difficulty of diagnosing hernia in the linea alba especially in children. He stated that the protrusion of a small tumor through a slit in the aponeurosis can be detected only by having the patient cough repeatedly. Ordinarily, the plug of fat slips back beneath the fascia, and nothing can be felt on palpation.

As early as 1748, Arnaud called attention to the importance of examining the patient in the erect position. A very small hernia can often be seen in profile when the patient coughs or strains.

Litten's Sign.—This sign is also best elicited with the patient in the erect position and with shoulders thrown back, or it can sometimes be detected in the recumbent posture. If the examiner will place his hand on the abdomen over the suspected hernia, and request the patient to cough, he will feel a vibration or tremor such as would be experienced if liquid or a handful of peas were thrown against his hand. Litten believed this sensation is due to the presence in the sac of intestine containing fluid, and to small lobules of fat in the omentum which are forced outward by the impulse of coughing.

Pain.—The reflex gastric pain is probably due to traction on the great omentum, which is attached to the greater curvature of the stomach and during the attacks, a piece of the omentum is caught between the sharp edges of the slit in the fascia. When the omentum slips back into the abdominal cavity the pain disappears. Traction on the falciform ligament of the liver is responsible for the gastric pain in those small hernias in which this ligament or the fat between its layers is the sole content of the hernia. Gussenbauer explains the severe symptoms that occur in certain cases as being due to pressure on one or more of the nerve filaments of the five lower intercostal nerves which pass through openings in the linea alba. These intercostal nerves anastomose with the phrenics in the diaphragm.

In about 25 per cent of epigastric hernias with symptoms, there are changes in the gastric juice and in the physical signs of the stomach itself. The most frequent of these symptoms are: Hyperacidity, lessened motility, gastroptosis and dilatation. Alessandrini reported a case in which an epi-

gastric hernia and a gastric ulcer existed in the same patient; the hernia did not become painful until the ulcer developed. Cobb observed a patient who complained of epigastric hernia and persistent diarrhea which was not relieved by medical treatment. At operation the omentum was found adherent in the sac and the transverse colon was adherent to the abdominal wall at the hernial opening. The diarrhea did not recur after operation. Urrutia has reported a case of epigastric hernia complicated by double duodenal ulcer. Both ulcers perforated, 10 months elapsing between perforations. The ulcerated area was finally resected and a gastroenterostomy done.

Morris reported the case of a man, aged 68, who complained of a "lump in his stomach," abdominal pain, violent vomiting at times, constipation and a persistent cough. At operation two small hernias were found in the linea alba, one beneath the ensiform cartilage and the other just above the umbilicus. Each contained a loop of the falciform ligament of the liver.

Complications.—Irreducibility is infrequent. In 116 cases of hernia in the linea alba collected by Berger, 12 were irreducible. Epiploitis sometimes occurs and may be mistaken for strangulation.

Strangulation.—Strangulation of hernia in the linea alba is unusual, and the symptoms do not differ from those in other varieties of hernia. Along with the constipation and vomiting, there is a sharp continuous pain in the upper abdomen, with a tender irreducible mass in the linea alba that may be no longer than the end of a thumb; or, in rare instances, it may be the size of a fetal head. The severity of the symptoms depends on the viscera that are strangulated. The symptoms of omental strangulation are often indefinite, and are liable to be mistaken for those associated with abscess of the abdominal wall. Strangulation may occur at any age. Fraser has reported a case in a woman, 101 years old, who was successfully operated on under local anesthesia. The sac contained omentum and transverse colon.

Differential Diagnosis

Small hernias in the linea alba, especially the epigastric variety, must be distinguished from diseases of the upper abdomen:

Gastric and Duodenal Ulcer.—Hernia in the linea alba has often been confused with gastric or duodenal ulcer, and sometimes the two conditions exist at the same time. The presence of a tumor or a slit-like opening in the linea alba, with or without the protrusion of a small mass on coughing, will help to establish a diagnosis of hernia. In gastric ulcer there is a localized point of tenderness in the linea alba, as is always found in hernia. In ulcer the symptoms come on at a certain interval after eating, while in hernia the paroxysmal attacks have no relation to meals but usually follow physical exertion, and the patient finds that the most relief is secured by assuming a doubled-up position, which relaxes the linea alba. In hernia, relief is sometimes secured by lying on the back; and in ulcer, by lying on the right

side. In 695 cases of gastric and duodenal ulcer reported by Mandl, 14 patients had hernia in the linea alba (2.3 per cent). In another series of 40 patients operated on for hernia in the linea alba, 15 had an ulcer of the stomach or duodenum (35 per cent).

Cholelithiasis.—Hernia in the linea alba is sometimes mistaken for gall-stone attacks. In hernia there will be an absence of jaundice, leukocytosis, and pain over the gall-bladder, all symptoms that are characteristic of gall-stone colic.

Other Conditions.—Other diseases that hernia in the linea alba has been mistaken for are: Habitual epigastric protrusion in children, gastritis, gastralgia, carcinoma of the stomach or intestine, cholecystitis, colitis, appendicitis, nephrolithiasis, angina pectoris, abscess or tumor in the abdominal wall, and the gastric crises of tabes.

Cancer of the Stomach and Epigastric Hernia.—Cases of carcinoma of the stomach and epigastric hernia in the same patient have been reported by Capelle, Poisson, Schloffer, Lewisohn, Zeno, and others.

Roentgen-Ray Examination.—When the epigastric hernia is complicated by gastrointestinal symptoms, even though they are mild, a roentgen-ray examination is important for diagnosis because of the frequent association of gastric and duodenal ulcer with this variety of hernia. Sometimes when the roentgen-ray examination is negative, it is advisable to do an exploratory laparotomy at the time of the hernioplasty.

Prognosis

In children hernias in the linea alba tend to close spontaneously as the child grows older. This is especially true of small openings below the umbilicus. Above the umbilicus, the fascia is thinner and the openings are usually larger. Seventy-five per cent of the small reducible hernias produce no symptoms and do not incapacitate the patient. On the other hand, the remaining 25 per cent cause more severe symptoms than any other variety of the small hernias.

Strangulation is infrequent because these hernias almost always consist only of fat or omentum. The presence of intestine or stomach in the sac is very rare on account of the opening being located high up on the abdominal wall and the tendency of the intestines to gravitate downwards, while the stomach occupies a relatively fixed position.

Operative treatment is always to be recommended for hernias in the linea alba which are increasing in size or producing symptoms. The operation for hernia alone is comparatively simple, almost free from danger, and the results are uniformly good, both in adults and children.

Recurrence.—Recurrence following the operation for hernia of the linea alba is very slight with present-day methods. Vulpis reported 6 relapses in 41 operations; Le Page had 3 recurrences in 16 operations, and Witzel had

5 in 25 operations. In 35 patients operated on in the Breslau Clinic and reported by Capelle, there was 12 per cent of recurrence within a year. The operation employed was a simple linear suture of the fascia; Capelle blamed this method for the high percentage of recurrence in this group.

The prognosis concerning the relief of abdominal pain and other symptoms should always be guarded. In 12 patients operated on by Lindenstein, 11 were free from symptoms five years after operation.

Treatment

Operation is the treatment of choice for hernia in the linea alba because the outlook for permanent cure is good, and the danger of the procedure is very slight.

Mechanical Treatment.—Mechanical treatment is unsatisfactory on account of the pain and discomfort caused by the appliance, and the difficulty of holding the hernia. However, it has its place in the treatment of very small hernias in young children when the chance of spontaneous closure of the opening is good. Strips of adhesive plaster should be applied in these cases in the same manner as described for the treatment of umbilical hernia. When the general condition of the patient does not justify an operation, and when there is little chance of returning the hernial contents to the abdominal cavity and successfully closing the opening, bandage and truss treatment should be employed. An umbilical frame truss can be used for small reducible hernias either above or below the navel.

Radical Operation.—There are two types of operations for hernias in the linea alba: First, intraperitoneal; and second, extraperitoneal.

1. *The intraperitoneal operation* is indicated for hernias that contain viscera, and it is necessary as a means of diagnosis in cases with obscure gastrointestinal, gall-bladder, or appendix symptoms. The technic is similar to that already described for small umbilical hernia.

2. *The extraperitoneal operation* is usually sufficient for properitoneal lipomas and the small hernias. A small vertical or transverse incision is made over the center of the mass, and the skin and subcutaneous tissues are carefully divided down to the hernia. If the hernia consists of a properitoneal lipoma, the fat is carefully separated and the blood vessel located, usually on the right side of the mass. This vessel should be ligated as high as possible, and the lipoma ligated also before excising it, so there will be no secondary hemorrhage. After pushing these stumps back into the opening, the fascia is closed by one or two sutures. If a sac is present, either as a sole content of the hernia or if it is hidden by a properitoneal lipoma and exposed by traction, it should be opened, the contents reduced and any adhesions separated.

The redundant portion of the sac should now be excised and the wound closed in layers. I believe there is less chance of recurrence in all hernias in the linea alba, whether they are simple properitoneal lipomas or hernias

with sacs, if the fascial flaps are overlapped, according to the method described for umbilical hernia. (Figs. 149 and 150.) More elaborate and compli-



Fig. 149.—Operation for hernia in the linea alba. A small vertical incision is made over the center of the mass. The skin and subcutaneous tissues are carefully divided down to the hernia. If the mass consists of a properitoneal lipoma, the fat is separated and the blood vessel located and ligated as high as possible. The lipoma is ligated before being excised so as to avoid secondary hemorrhage.

cated plastic operations have been devised by Graser, Menge and others, but the results are no better than those obtained by simple overlapping of fascial flaps.

Traumatic hernias in the linea alba should be treated by overlapping broad flaps of fascia, reenforced on each side by additional flaps of fascia from the anterior sheath of the rectus muscle. Free fascial transplants from the fascia lata of the thigh or fascia from other regions, may be used to close any remaining gaps.

(Strangulation of hernia in the linea alba is rare. The treatment is the same as for strangulated umbilical hernia.)

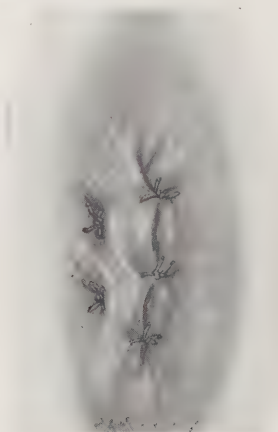


Fig. 150.—Operation for hernia in the linea alba. The fascia is closed by overlapping the flaps. The subcutaneous tissues and skin are closed in the usual manner without drainage.

LATERAL VENTRAL HERNIA

Synonyms.—Laparocele; Ventral hernia.

Definition.—Lateral ventral hernia is a protrusion of abdominal viscera through the anterior abdominal wall, occurring at points other than the inguinal, femoral, or umbilical openings, or in the linea alba. Lateral ventral hernia may appear anywhere in the lateral abdominal wall.

La Chausse, in 1721, was probably the first to recognize hernia in the linea semilunaris; he called it a “rare and hidden species of hernia.” Le Dran also described the condition in 1731.

From an etiologic standpoint, it is most convenient to consider these hernias in two groups: 1. Spontaneous; 2. Traumatic.

1. **Spontaneous.**—Spontaneous ventral hernias are rare. The variety that occurs most frequently is hernia in the linea semilunaris, and the opening is situated between the fibrous edge of the semilunar line and the rectus muscle.

The hernia may occur through the outer edge of the linea semilunaris, or through the linea transversa, or through an opening in the lower portion of the aponeuroses of the external and internal oblique muscles between the iliac crest and the false ribs, or through the rectus muscle and fascia.

2. **Traumatic.**—Traumatic or postoperative hernias may appear anywhere in the abdominal wall.

HERNIA IN THE LINEA SEMILUNARIS

Synonyms.—Hernia in the semicircularia Spigeli, or Spiegel's hernia; *Laparocèles spontanées*.

Anatomy

The Lineae Semilunares.—The linea semilunares are two curved tendinous lines situated on each side of the linea alba, and joined to the latter by the lineae transversae. Each semilunar line extends from the cartilage of the ninth rib to the pubic spine and corresponds to the outer border of the rectus muscle. The linea semilunaris is formed by the aponeurosis of the internal oblique at its point of division to enclose the rectus muscle, where it is reenforced for its upper three-fourths by the external oblique in front, and the transversalis behind. At the junction of the upper three-fourths with the lower fourth, the posterior sheath of the rectus terminates in a thin curved margin, having its concavity downward, and is known as the semilunar fold of Douglas. In the lower fourth of the rectus, the aponeuroses of the external and internal oblique and transversalis pass in front of the rectus muscle. The extremities of the folds of Douglas descend as pillars to the os pubis. (Fig. 151.) A majority of hernias in the linea semilunares occur close to the pubes and are commonly classed as direct inguinal hernias. Eccles terms these "ventro-inguinal hernias."

Hernias in the linea semilunaris are often divided into two varieties: Those appearing above the deep epigastric artery, and those below it.

Hernias above the deep epigastric artery are very rarely above the umbilicus. Hernias below the deep epigastric artery and on a level with the semilunar fold of Douglas, are the more common. They appear between the deep epigastric artery and the edge of the rectus muscle, in Hesselbach's triangle. (These hernias are fully described under direct inguinal hernia.) In 23 cases of hernia in the linea semilunaris collected by Cooper, only four occurred above the navel. In 1919 Barthélemy could find reports of only 22 cases of true spontaneous hernia in the linea semilunaris; to these he was able to add one case of his own. I have observed a hernia of this variety in a man aged 70.

The Hernial Opening.—The hernial opening is usually situated at the weak point, the semilunar fold of Douglas, where the posterior rectus sheath is deficient. This hernia is nearly always found at the inner third of a line passing from the anterior superior spine of the ilium to the umbilicus. In the beginning the tumor is interstitial, deeply situated and difficult to outline. Later on it becomes subcutaneous and is easily found under the thin layers of the abdominal wall. It is always at the outer edge of the rectus at the point where the posterior sheath forms the fold of Douglas.

The lineae semilunares can be outlined by drawing a curved line with its

convexity outward from the end of the cartilage of the ninth rib to the pubic spine. The center of the curved line at the umbilicus or near it should be three inches (7.5 cm.) from the median line (Gray).

The hernia may have more than one opening. In rare instances, a portion

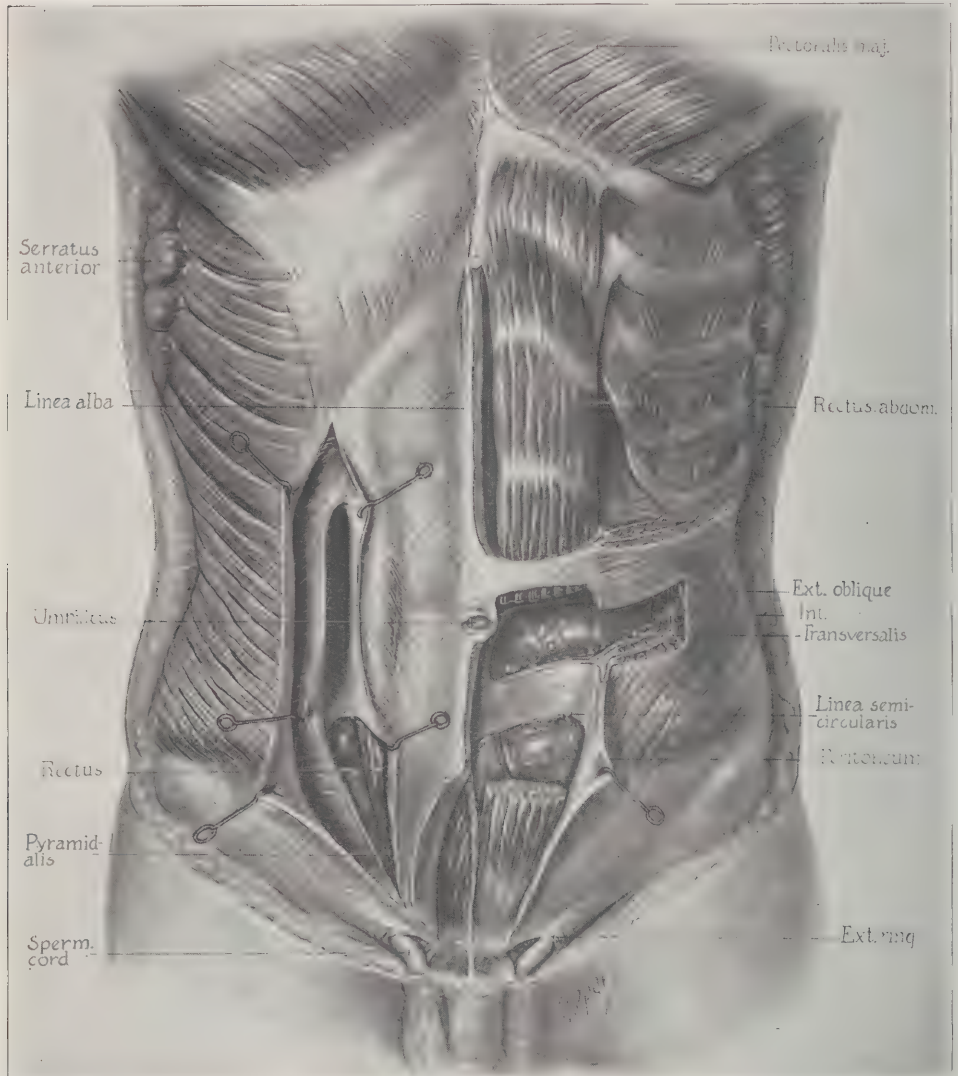


Fig. 151.—The superficial and deep anatomy of the anterior abdominal wall.

of the hernia is subcutaneous and the remainder is interstitial; or there may be two diverticula, one subcutaneous and the other properitoneal. Hernias in the linea semilunaris are usually interstitial, and situated beneath the external oblique aponeurosis and in front of the transversalis fascia. Mac-

ready termed these "masked hernias." The hernial orifice is usually narrow and crescent-shaped.

The Hernial Sac.—There is always a sac in spontaneous hernias in the linea semilunaris. It is globular, gourd, or mushroom shaped, depending on its size. In front of the sac there will often be a lipoma, which may constitute the bulk of the mass. In the large hernias the peritoneum is frequently adherent at the ring and is difficult to separate on account of the thinness of the sac. Traumatic eventrations are almost always without a sac.

Contents of the Sac.—Omentum and small intestine are most often found in the sac. The large intestine, cecum, and sigmoid are seldom present in



Fig. 152.—Hernia in the right linea semilunaris in a man, aged 79. There is also a direct inguinal hernia on the left side.

reducible hernia; in strangulation large intestine is usually found. In 42 cases of lateral ventral hernia collected from the literature by Stühmer, large intestine was alone in the sac in 25 cases; large intestine and omentum were together in 7; large intestine and small intestine in one case; small intestine was alone in 3 cases; omentum alone in 4; and the bladder alone in 1 case. Petit found the stomach in a nonstrangulated hernia; Lockwood saw an epiploic appendix, and Giordano and Schoofs each saw a sac containing a testicle.

The Size of the Hernia.—The spontaneous hernias in the linea semilunaris are usually quite small, sometimes the size of a hen's egg, and very rarely as large as an orange. (Fig. 152.)

Hernia in the Linea Transversa.—The linea transversae are narrow transverse fibrous lines that intersect the recti muscles and connect the linea alba with the lineae semilunares. One of the transverse fibrous bands is at the level of the umbilicus, one opposite the tip of the ensiform cartilage, and another midway between the ensiform and the umbilicus. In rare instances there is a transverse line below the umbilicus. The linea transversae extend only through the anterior half of the recti muscles. Macready reported 7 cases of this variety of hernia; 5 of these were in the transverse line opposite the umbilicus, one in the transverse line above the umbilicus, and the other just below the midpoint between the ensiform and the umbilicus. Five were on the right side, 2 on the left; 2 occurred in females, and 5 in males.

Hernia in the Sheath of the Rectus Muscle.—Hernia in the sheath of the rectus muscle is very rare and always follows rupture of the rectus muscle and its fascia. It almost always occurs below the umbilicus where the posterior part of the sheath is thin. The omentum is usually found in these hernias, as in the case reported by Le Dran in 1731. When irreducible, the hernia cannot be distinguished from hernias in the semilunar or transverse lines except by operation.

Absence of Abdominal Walls.—An absence of the abdominal walls or a lateral bulging is an eventration and is not to be mistaken for a true hernia. These protrusions are most frequently encountered in the lumbar region; as a rule, they are due to an arrest in development or to a congenital malformation, comparable to the etiology of congenital diaphragmatic hernia or to muscular paralysis. This condition must be distinguished from lumbar hernia, from lateral bulging of the abdominal wall without loss of muscle substance, from epigastric protrusion in children, and from local bulgings in the inguinal region in adults.

Etiology

It is most convenient to consider the causes of lateral ventral hernia under two headings: 1. Spontaneous; 2. Traumatic.

1. **Spontaneous.**—The most frequent causes of spontaneous lateral ventral hernia are: Multiple pregnancies, obesity, marked emaciation after obesity, ascites, maldevelopment of the abdominal wall, and muscular paralysis. Acute anterior poliomyelitis is probably one of the most common causes, especially in children (Baracz, Blauel). These hernias usually occur in middle life and the sexes are equally affected. Barthélemy was able to collect 23 cases in the literature; of these, all occurred in adults, and all were first noticed following a sudden strain.

Cooper believed that lateral ventral hernias escape through one of the tiny openings for the blood vessels. This opinion was shared by Makroeki, Reignier, and some of the early writers. Ferrand, Thévenot and Gabourd believed that a weak spot exists where the deep epigastric artery pierces the

fascia at the semilunar fold of Douglas. Barthélemy denied that the hernia escapes through one of the vascular foramina, and agreed with Mollière, who, in 1877, stated that the cause of these hernias is due to the arrangement of the layers of fascia in relation to the rectus muscle. In some cases the fascia is loosely attached to the muscle, and then there may be a diverticulum or pocket opening downward or inward, through which a hernia may occur following a sudden strain when the body is bent forward. When the erect



Fig. 153.—Lateral ventral hernia in a woman, aged 40. Postoperative hernia following a gall-bladder and appendix incision.

position is assumed the mass is caught in the diverticulum. There is also danger of strangulation when the sac is distensible and has a very narrow peritoneal opening.

Oehlecker observed a number of cases in soldiers where a unilateral partial paralysis of the abdominal wall had been caused by the severing of intercostal nerves. The condition of pseudohernia may be recognized by having the patient increase his intraabdominal tension, and by testing the local sensibility.

2. **Traumatic.**—Traumatic hernia is also termed accidental, incisional, postoperative or cicatricial hernia. It may be due to direct injury, such as a crushing blow or a fall from a height, but the most common causes are, postoperative suppuration in the abdominal wall, and the use of drains that are larger than necessary, faulty closure of the muscle and fascia layers, and the division of nerves supplying the muscles. Unusual causes are: Tumors in the abdominal wall, hematomas, distention and weakening of the abdominal wall due to obesity, ascites or intraabdominal tumors.

The hernia may appear immediately after injury, as true traumatic hernias do, but when it is postoperative it may not be noticed for several months, as the scar tissue is distended and gives away slowly while the hernia is small. These hernias may occur anywhere in the abdominal wall; they are most frequent after operations for appendicitis. Sometimes they come through following the midline incision in the linea alba, and occasionally they arise from an operation on the gall-bladder. (Fig. 153.) The best gall-bladder incision to preserve the nerve supply of the upper abdomen is Bevan's modified S-incision, which conserves the nerve supply of $\frac{1}{3}$ of the rectus muscle, as the muscle fibers are split near their inner border so that $\frac{1}{3}$ of the muscle is to the outer side.

In 1887 Homans estimated that 10 per cent of all abdominal operations were followed by hernia. In 1892 Marcy found that by using absorbable suture material his recurrence was reduced to 1 per cent. Nigst observed 14 hernias in a group of 117 drained appendectomies. (There is less tendency to hernia with the McBurney incision.) The edges of the wound should always be sutured close up to the drainage tubes, which should be as small as possible. A drain should never be used in clean cases but when one is necessary, I prefer it made from a wick of gutta serena or rubber tissue.

In a series of 500 laparotomies reported by Stanton, the midline or rectus incisions gave less than one-half of 1 per cent of hernias. In 260 clean cases, only 3 postoperative hernias developed, while in 186 operations in an infected field, 18 hernias resulted. In 35 cases of postoperative hernia observed by Warren, 13 followed appendectomies and 22 developed after median and paramedian laparotomies. There were 2 cases of strangulation in this group. These 35 patients were operated on without a fatality. Warren reported 1000 appendectomies through a McBurney incision and estimated the postoperative hernias at 2 per cent.

Symptoms and Diagnosis

The symptoms of small spontaneous lateral ventral hernias are often obscure and diagnosis is difficult. This is especially true of hernias in the linea semilunaris, which often do not entirely penetrate the abdominal wall, and are known as "interstitial hernias." In a case reported by Robinson, in a woman, aged 70, with a history of intestinal obstruction for four days,

there was no apparent swelling, but a small lump, deeply situated could be felt at the outer margin of the fold of Douglas.

In certain instances diagnosis is possible only after an exploratory laparotomy. Postoperative ventral hernias offer no difficulties in diagnosis; the symptoms are those common to all hernias, and the tumor may reach large proportions. The scar of the former operation is discernible on the surface of the hernia.

Functional Symptoms.—The functional or subjective symptoms resemble those of large hernias in the linea alba. Acute attacks of pain with gastrointestinal symptoms, colic, constipation and partial obstruction are the rule. They are aggravated by coughing, pressure, and physical exertion.

Objective Signs.—The signs of small lateral ventral hernia are often indefinite, especially if the patient is obese, and it is difficult to palpate the tumor. A careful examination will almost always disclose a localized point of tenderness, which is best elicited with the patient in the erect position. An impulse on coughing may be felt over the painful spot. Sometimes the tumor can be seen in profile with the patient standing. The small interstitial hernias in the linea semilunaris may give only a slight fullness or bulging on the affected side.

When the hernia is large and reducible, diagnosis is simple. If it is irreducible, often the exact position of the opening can be determined only by operation. The history of a previous operation or the presence of a scar over the mass, will aid in establishing diagnosis. These large hernias are held in at the neck by a firm ring of fascia. Beyond the confines of this constriction, the hernia has a tendency to spread out in the shape of a mushroom and burrow outward beneath the subcutaneous tissues. The usual direction of greatest enlargement is downward. In massive ventral hernias the pendulous tumor may reach to the knees.

Complications.—1. *Strangulation.*—Strangulation is not common in traumatic ventral hernias because the ring is large. When it does occur, however, the point of constriction is usually found at the neck of the sac in the aponeurosis of the external oblique. In rare instances there is a second point of constriction at the level of the peritoneal opening. Intrascacular strangulation occurs occasionally, as it does in umbilical hernia.

While hernias in the linea semilunaris are rare, strangulation is comparatively frequent. If the hernia is small and interstitial, diagnosis is difficult or impossible without an incision over the suspected tumor or an exploratory laparotomy.

2. *Rupture of the Sac.*—Due to its exposed position, the skin over the fundus of the sac is subjected to occasional contusions, and irritation and dermatitis caused by the rubbing of clothing. This inflammation produces omental adhesions within the sac and a thinning of the overlying structures, consequently this point is often the seat of ulceration. Sometimes the sac

will suddenly tear following a strain or fall, and intestine will escape through the rent; in this event operation should be performed, the earlier it is done the more favorable the prognosis.

In almost all of the delayed operations that have been reported, the patients have died of peritonitis. The tear in the sac may be very small. Vaughan reported a case in which it was no larger than the tip of a finger, and 12 inches (30 cm.) of intestine escaped. The bowel was cleansed and replaced, the scar excised, the hernial opening closed, and after some localized peritonitis the patient recovered. Sometimes the rent may be large, extending the length of the scar.

Differential Diagnosis

The following conditions are to be thought of when examining for ventral hernia: Diseases of the stomach, intestines, and gall-bladder, inflammation and tumors of the abdominal wall. The foci of infection in tuberculous peritonitis may be localized behind the rectus muscle and simulate an irreducible hernia. The symptoms of cholecystitis and ureteral colic have been mistaken for those of strangulated ventral hernia. In rare instances small strangulated ventral hernia may be mistaken for intestinal obstruction. Lumbar hernia must not be confused with lateral ventral hernia. The former will appear behind the posterior border of the external oblique and will come through the triangle of Grynfeltt-Lesshaft, or the triangle of Petit.

Prognosis

Spontaneous hernias in the linea semilunaris are usually small. They do not produce marked symptoms, and do not strangulate as frequently as hernias in the linea alba.

Traumatic ventral hernias have no tendency to spontaneous cure. On the other hand, they progressively increase in size and are almost impossible to control with a truss on account of the large hernial ring. For this same reason strangulation is uncommon. The large hernias are frequently irreducible on account of the rapid growth of fat and omentum within the sac. Intrascacular adhesions form early, both between the contents and between the omentum and the sac walls. The skin over the fundus of the hernia is often the site of irritation and ulceration. The sac occasionally ruptures, making the prognosis grave. Patients with large irreducible hernias often become confirmed invalids, unless relieved by operation.

The outlook for cure by operation depends on the size of the hernia. The spontaneous hernias in the linea semilunaris and the small traumatic hernias respond favorably with a low percentage of recurrence. For massive ventral hernia, operation also offers the best chance of cure and relief from invalidism, just as it does in voluminous umbilical hernia.

The Prevention of Hernia Following Laparotomy.—The prevention of hernia following abdominal operations depends largely upon the incision employed, the method of closing the wound, and absolute asepsis. The incision for any procedure should be made so as to damage as little as possible the important structures of the abdominal wall, the motor nerves, muscles, fascia, and blood vessels.

The motor nerves that supply the lateral abdominal wall are branches of the fifth and sixth lower intercostal nerves, which run nearly transversely forward after leaving the intercostal spaces, and lie between the transversalis and internal oblique muscles. After giving off branches to these muscles, as well as to the external oblique, the nerves finally perforate the posterior sheath of the rectus muscle and terminate in the muscle. For this reason, abdominal incisions should be made as near the linea alba as possible, but when it is necessary to enter the abdomen through the lateral abdominal wall, the incision should run parallel to the motor nerves in order to avoid muscular paralysis, which will occur if these nerves are severed. Division of the nerves, not only favors the occurrence of hernia, but also a lateral bulging of the abdominal wall for which there is no operative relief.

A muscle-splitting incision should be used, when possible. In long incisions through the external and internal oblique and transversalis muscles, whose fibers run at different angles, it is impossible to avoid cutting some of the fibers, and the incision should be planned so as to sacrifice the minimum amount of muscle, and to preserve the motor nerves. Whenever possible, it should be made through the rectus muscle, rather than in the linea alba or linea semilunaris. Tinker has shown that the muscle-splitting or the rectus retraction incisions give the lowest percentage of hernias. Assmy found, from experimental studies, that muscle atrophy always occurs when the motor nerve supply is severed. Rouffart collected from the literature 1,506 cases in which the transverse abdominal incision was used in the lower abdomen. Hernia developed in only 0.33 per cent of the cases.

It must be remembered that two short incisions heal quicker and more firmly than one long incision, and strong retraction is always to be avoided. The fascia is the strongest structure in the abdominal wall, and it is very essential to close it properly. The fascia is frequently under tension and unites more slowly than muscle tissue; for this reason, a simple approximation of the edges is not sufficient, but it is necessary to overlap each layer separately. When closure under tension is unavoidable, the patient's shoulders should be kept in a semi-reclining position and the knees elevated on pillows for a week after operation. Because fascia is always slow in uniting, the patient should be kept in bed at least three weeks if the closure of the wound has been difficult.

The deep epigastric artery is the most important one to be encountered and should be preserved whenever possible on account of its branches to the

muscles of the lower abdomen. All hemorrhage should be carefully checked before closing the wound, as hematomas are liable to form and cause post-operative hernia.

The importance of using absorbable suture material in all abdominal wound closures cannot be overemphasized. Tension or stay-sutures are of service to prevent strain on the fascia sutures. A gain in weight after operation, especially in obese subjects, increases the intraabdominal tension and weakens the abdominal wall. The use of an elastic belt after operations checks the tendency to rapid accumulation of fat. (See chapter on umbilical hernia.)

Meteorism or gas pains predispose to a weakening of the abdominal closure by producing tension on the sutures. This complication can be minimized by proper preoperative treatment and postoperative measures. I have found that it is decidedly lessened by changing the patient's position frequently, and by massage of the abdomen at a distance from the incision, for a period of ten or fifteen minutes every hour during the first two days. Patients often remark they can feel the gas moving under this treatment.

Treatment

The operation is indicated in all cases of ventral hernia, except in those patients whose general condition does not warrant the undertaking of any operative procedure, or when there is no prospect of reducing the hernia and closing the opening.

Spontaneous hernias in the linea semilunaris and small traumatic hernias are easily cured by the radical operation, and the percentage of recurrence is very low. The massive ventral hernias are always serious because of the difficulties of treatment. In obese subjects the amount of fat in the hernia should be reduced and intraabdominal tension lessened by appropriate preoperative diet and exercise as described under umbilical hernia.

Mechanical Treatment.—Small ventral hernias can be controlled more or less satisfactorily by a truss, but there is little prospect of a cure by this means. If the hernia is in the median or paramedian line an umbilical truss can be used; while if the protrusion is in the appendix or inguinal region an inguinal truss can be applied. Because of the large hernial opening and the accumulation of fat in the abdominal wall, massive ventral hernias can seldom be held by a truss. Although a belt will give the patient some comfort, it will not keep the hernia from increasing in size. For these voluminous hernias the belt must be made of heavy canvas; elastic material which is sometimes used to save trouble in fitting, is seldom satisfactory.

Taxis.—Taxis is dangerous and is never to be employed in this variety of strangulated hernia on account of the danger of reduction *en masse*.

The Radical Operation.—The operative treatment for ventral hernia is similar to that already described in more detail for umbilical hernia. Ventral

hernias in the median and paramedian lines are exposed by a vertical or transverse incision over the tumor. In postoperative hernia the scar is excised and the sac opened to one side of the site of the former operation, so as to avoid adhesions that may have been formed between the sac contents and the peritoneum. In ventral hernia, as well as in umbilical, the adhesions are always most dense over the fundus. Adherent omentum should be ligated in small sections, excised, and all bleeding points carefully secured. The hernial ring is freely exposed, and the fat stripped away from the fascia for a distance of two inches (5 cm.) from the edge of the opening. The fascia is now incised at either side and the retracted muscle edges secured and two transverse flaps formed, one above and one below. The sac is excised, if the hernia is small and there are no adhesions; if it is large and adherent, it is inverted and folded on itself in the shape of a pad to help reenforce the closure. The posterior layer of fascia together with the peritoneum, if the latter has been opened, are brought together and sutured; the freshened muscle edges are approximated and sutured, and finally the transverse fascial flaps are overlapped and stitched with chromic catgut. If the opening is oval or round, the best results are secured by overlapping the flaps from above downward, but if the wound is elliptical, and the patient not obese, it is usually advisable to overlap the flaps from side to side.

The repair of ventral hernia by autoplasmic flaps of fascia, muscle, peritoneum and scar tissue, without attempting to separate the different layers, has been described by Judd: After freeing the neck of the sac from the aponeurosis and stripping the fat from the fascia, the peritoneal sac is opened, freed from adhesions on the inside for an inch (2.5 cm.) beyond the opening and the flaps overlapped in the direction of least tension, side-to-side, above downward, or obliquely. The peritoneal surface of one flap lies on the aponeurosis of the other, and several mattress sutures of chromic catgut are passed through the outer flap and then through the free edge of the inner flap. When the sutures are tied, the inner flap is drawn up beneath the outer one. The free edge of the outer flap is now turned back, and the peritoneal surface is stitched to the aponeurosis of the inner flap. Finally, the edge of the outer flap is sutured to the aponeurosis overlying the deep flap.

In large hernial openings, when it is difficult to bring the fascial flaps together, it can sometimes be accomplished by separating the flap for some distance from the underlying muscle. If the flaps are brought together under considerable tension, or if the hernial opening is in the upper abdomen and the movement of the lower ribs is interfered with, there is a strong probability that the hernia will recur, unless the line of suture is reenforced by a flap turned up from the sheath of the rectus, or by a transplant of fascia lata similar to that used to close a gap when the edges of the wound cannot be approximated. Fascia lata taken from the lower part of the ilio-tibial band of the thigh makes the best graft. The transplant should be a little

larger than the defect to be covered, and it is placed directly over the hernial sac and sutured to the edge of the opening with chromic catgut. Neuhof successfully closed a gap measuring two and one-half by five inches (6×12 cm.) in the gall-bladder region, with a fascia lata transplant. Bartlett has written at length on the indications and methods of applying fascia transplants in hernia operations. König advocates the use of osteoplastic transplants taken from the tibia. Silver filigree, decalcified bone and other materials have been used to close these openings, but are seldom employed at the present time because of their tendency to produce suppuration.

Haynes employs an inversion operation for massive ventral hernias: The sac is exposed by elliptical incisions, and the fascia is freed of fat for a distance of two inches (5 cm.) from the hernial orifice. Then the elliptical mass of skin and a corresponding portion of the sac are removed, and the peritoneal cavity opened. The thick and adherent omentum is excised, and the peritoneal cavity closed by continuous suture with No. 2 plain catgut. Before the sac is closed, the first row of inverting sutures of heavy kangaroo tendon is inserted at the edge of the hernial opening. These sutures bite deep, three-quarters of an inch (1.8 cm.), and are placed one-half an inch (1.25 cm.) apart; after the sac is closed they are tied, inverting the omentum and sac into the abdominal cavity. A second row of the same suture material is now placed one inch (2.5 cm.) outside the first row and tied; retention sutures are next inserted through the skin two to four inches (5 to 10 cm.) from the margin of the incision and two inches (5 cm.) apart in a figure-of-eight manner, taking a deep bite into the fascia. These retention sutures are now tightened, inverting the last row of kangaroo sutures, and relieving it of strain.

In massive ventral hernia, Gibson closes the opening by approximating the freshened edges of the sheath of the rectus: Tension is relieved by incisions parallel to the line of suture on both sides. The hernial contents are reduced, the sac freed, and each layer closed separately. The peritoneum is easily brought together, and as much muscle tissue as possible is secured and sutured under the fascial layer. The releasing incisions should be made in large hernias before the fascia is sutured. The length and width of the flap of fascia is determined by the degree of tension; the releasing incisions must be long enough to take off all strain. Usually the flap of fascia is about two inches (5 cm.) wide.

Hernias in the upper midabdomen are the most difficult because the releasing incisions have to be carried on to the costal arch. Interrupted chromic catgut sutures are used for the fascial closure. It is sometimes advisable to reenforce the line of closure by through-and-through silkworm gut sutures, or with tension sutures tied over wooden or pearl buttons. The sutures may be left in as long as 20 days in large hernioplasties.

To relieve excessive tension on the sutures in repairing ventral hernia,

Henson makes a series of incisions, each one to one and a half inches (2.5 to 3.75 cm.) long, directed outward and upward obliquely across the fibers of the aponeurosis of the external oblique, just outside the rectus. The incisions should be made at such intervals that the outer end of each incision will cut fibers which lie just beyond the inner end of the incision below. After closing the hernial opening any gap in the incisions can be closed easily by sutures.

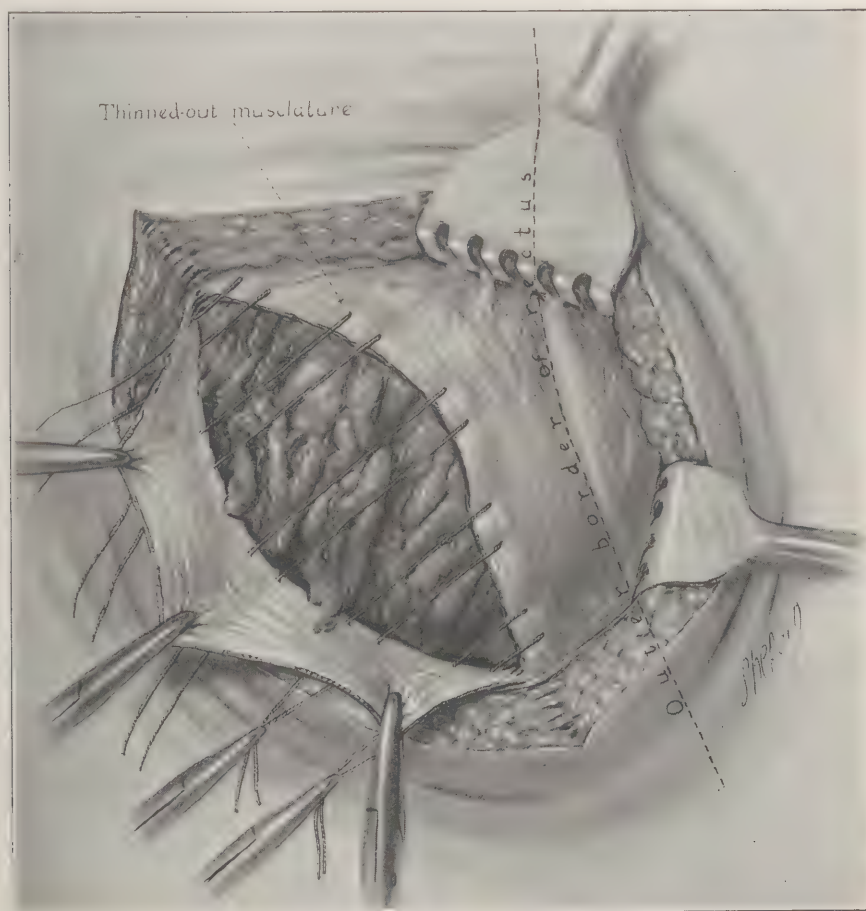


Fig. 154.—Operation for lateral ventral hernia following appendectomy. After dealing with the hernia, the abdominal wall should be reconstructed as well as possible. When the musculature and fasciae are very thin, they are used as a single flap which is drawn down, and sutured to the outer fascial edge of the wound (the external oblique aponeurosis, or Poupart's ligament).

Hernia Following Appendectomy.—In hernia following appendectomy, an elliptical incision should be used if the sac is thin and adherent to the skin; if the sac is not adherent, a vertical incision saves time. The skin incision can be made through the old scar or directly over the hernia, and extended down through the fat to the neck of the sac. Nothing is gained by opening

the fundus; the adhesions here often make it difficult or impossible to reach the neck of the sac, and time is saved by beginning the dissection at the neck and working inward. When there are no symptoms of obstruction, it is usually advisable to leave the sac; it is tedious to remove it, and new adhesions are liable to form, causing more trouble than the old ones. Besides, the sac can be inverted or folded on itself and used to reenforce the closure of

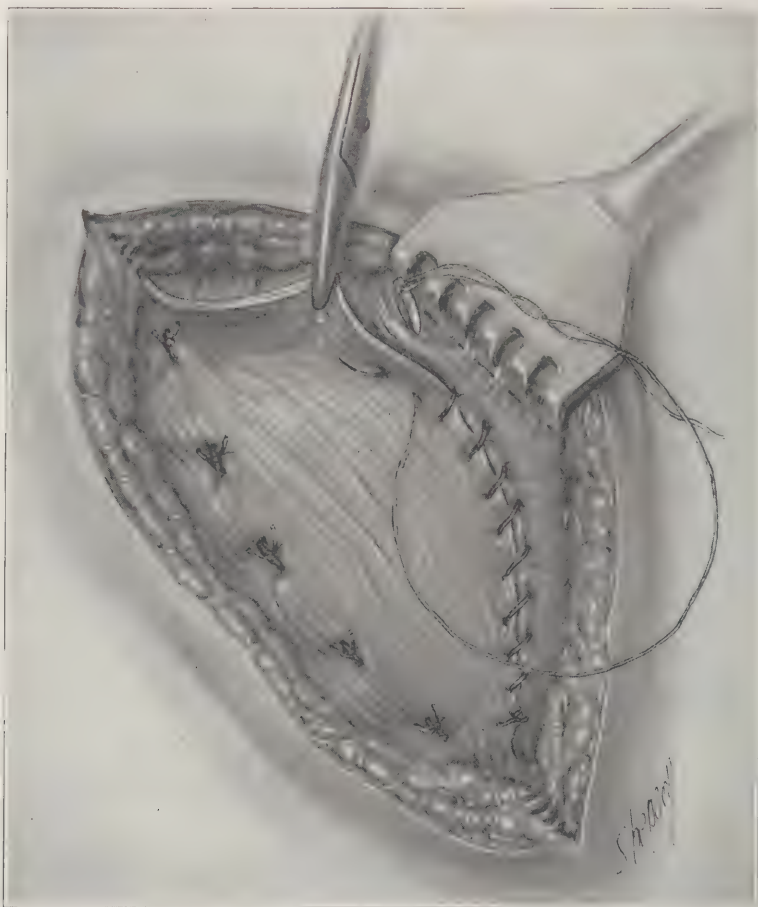


Fig. 155.—Operation for lateral ventral hernia following appendectomy. A simple approximation of the edges of the fascia is not sufficient to prevent recurrence. After overlapping the flaps for a distance of 1 to 2 inches (2.5 to 5 cm.), the free edge of the outer flap is fastened to the anterior surface of the aponeurosis of the inner flap by a continuous suture of chromicized catgut. Finally the subcutaneous tissues and skin are closed, and tension sutures are inserted to take the strain off the deep stitches.

the opening. If the sac is not removed it is important to sew up any holes in it to avoid the chance of strangulation through one of them.

I have found that the simplest method of exposing the hernial opening is to invert the sac on one or two fingers, and feel the sharp fascial edge which is usually most distinct on the outer side of the hernia near Poupart's

ligament. With the finger as a guide, the incision is made directly down to the fascia. Once the aponeurosis is located, it is easy to continue the incision and expose the fascia entirely around the neck of the sac. It is important to extend the dissection for some distance from the hernial opening in order to recognize the muscle and fascia layers and to secure flaps that can be united without undue tension.

The abdominal wall should be reconstructed as well as possible: The transversalis and internal oblique muscles and fascia have become so thin that they cannot be separated, and they should be used as a single flap, which is drawn down and sutured beneath the outer fascial edge of the wound, this edge being the external oblique aponeurosis or Poupart's ligament. The second flap, which is secured from the aponeurosis of the external oblique, is drawn down and lapped under Poupart's ligament and over the first flap. Sometimes the musculature and fascia are so thin that only one flap can be obtained. (Fig. 154.) A simple approximation of the edges of the fascia is not sufficient; they must be overlapped for a distance of one or two inches (2.5 or 5 cm.) to give the maximum of strength to the abdominal wall. (Fig. 155.) Finally, tension sutures must be inserted to take the strain off of the fascial stitches. When recurrence takes place, the hernia first appears at a point where the fascial closure is defective. This weak spot may be due to insufficient lapping of the fascial edges, to closure under too much tension, or to infection.

Lipectomy.—Lipectomy should be combined with the operation for ventral hernia in obese subjects with pendulous abdomens. The technic is the same as for lipectomy and umbilical herniorrhaphy.

Strangulation.—Spontaneous hernias in the linea semilunaris are almost always small and of the interstitial type. They are rare, but the percentage of strangulation is high. Abdominal rigidity, with a localized point of tenderness in the region of the fold of Douglas, if associated with the symptoms of intestinal obstruction, calls for immediate operation. The incision should be made directly over the point of tenderness. When diagnosis is impossible and there is no painful point, a median incision should be made and all the possible sites of hernial strangulation examined.

Strangulation of traumatic or postoperative ventral hernia is not common. When it occurs it is usually intrasaccular. An irreducible ventral hernia with symptoms of obstruction requires immediate operation. (The technic is the same as for umbilical hernia.)

Prevention of Postoperative Complications.—The preoperative treatment of the massive irreducible ventral hernias is very important, to minimize the danger of pulmonary edema, pneumonia, disturbances in the cardiovascular system, and acute dilatation of the stomach.

Bibliography

HERNIA IN THE LINEA ALBA

- AARON, C. D.: Stomach disturbances caused by hernia of the linea alba in the epigastrium. *Med. Rec.*, N. Y., 1897, lii, 736-738.
- ALESSANDRINI, P.: L'ernia epigastrica dolorosa quale sintoma di ulcera gastrica. *Polielin.*, Roma, 1913, xx, sez. prat., 1101-1104.
- ARNAUD, G.: A dissertation on hernias or ruptures. English transl. from the French. Lond., A. Millar, 1748, p. 125-127.
- BAINBRIDGE, W. S.: Multiple herniæ. *Post-Graduate*, N. Y., 1905, xx, 136-138.
- BARTHÉLEMY, M.: Pathogénie et anatomie pathologique des hernies épigastriques. *Lyon chirurg.*, 1920, xvii, 217-222.
- BERGER, P.: Résultats de l'examen de dix mille observations de hernies recueillies à la consultation des bandages a bureau central du 4 février 1881 au 14 août, 1884. *Cong. franç. de chir. Proc.-verb.* [etc.], Par., 1885, ix, 264-452.
- BERTRANDI, A.: Abhandlung von den chirurgischen operationen. Wien, R. Grässer, 1770, p. 37.
- BLUMER, G.: The medical aspects of hernia in the linea alba. *Yale M. J.*, N. Haven, 1908, xv, 19-28.
- BRANDENBERG, F.: Die hernia epigastrica im kindesalter. *Arch. f. Kinderh.*, Stuttg., 1912, lviii, 8-11.
- CAPELLE, W.: Dauerresultate nach operationen der hernia epigastrica. *Beitr. z. klin. Chir.*, Tübing., 1909, lxiii, 264-285.
- CLOQUET, J.: Recherches sur les causes et l'anatomie des hernies abdominales. Thèse, Paris, 1817.
- COBB, F.: Epigastric hernia, a cause of chronic diarrhea, with report of a case. *Ann. Surg.*, Phila., 1912, lv, 66-70.
- COLEY, W. B.: Hernia. *Progr. Med.*, Phila., Lea & Febiger, 1918, ii, 38.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts, 2nd ed., by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.
- CRUVEILHIER, J.: Traité d'anatomie pathologique. Paris, J. B. Baillière, 1849, i, p. 635-636.
- DENK, W.: Zur Pathologie und Therapie der Brüche der vorderen Bauchwand. *Arch. f. klin. Chir.*, Berlin, 1910, xciii, 711-728.
- EVELY, F.: Hernies épigastriques et troubles digestifs. *Polielin.*, Brux., 1913, xxii, 113-120.
- FORSYTH, W. H.: A case of suprapubic hernia. *Lancet*, Lond., 1917, i, 998.
- FRASER, F.: Strangulated epigastric hernia in a centenarian; operation; recovery. *Lancet*, Lond., 1913, clxxxv, 799.
- FRIEDRICH, W.: Ueber die Hernia epigastrica. *Wien. klin. Wehnschr.*, 1903, xvi, 1450-1457.
- DE GARENGEOT, R. J. C.: Sur plusieurs hernies singulieres. *Mém. Acad. roy. de chir.*, Par., 1743, i, 699-716.
- GRASER, E.: Zur Technik der Radicaloperation grosser Nabel- und Bauchwandhernien. *Arch. f. klin. Chir.*, Berl., 1906, lxxx, 324-349.
- GÜNZ, J. G.: Observationum anatomico-chirurgicarum de herniis libellus. Lipsiæ, J. C. Langenhemium, 1744.
- GUSSENBAUER, C.: Ueber Hernia epigastrica. *Prag. med. Wehnschr.*, 1884, ix, 1-4.
- GUY DE CHAULIAC: Arte medica exercitissimi chirurgia. Lugduni, Sebastianum Honoratum, 1572, p. 410-411.
- HALL, J. N.: Epigastric hernia in the soldier. *J. Am. Med. Assn.*, Chi., 1919, lxxiii, 171-172.
- HEDLUND: Hernia epigastrica med inkarcération af ventrikeln. *Medd. f. Läkarsällsk. i Lund, Förh.*, 1904-5, p. 6-13.
- HEROLD, A. A.: An epigastric hernia. *Med. Recorder*, Shreveport, La., 1907, iv, 161.
- HOIN, J. J. L.: See Le Blanc, L.: Nouvelle méthode d'opérer les hernies. Paris, Guillyn, 1768, p. 390-397.
- KIRMISSON: Volumineuse hernie sus-ombilicale avec ectopie cardiaque. *Bull. l'acad. de méd.*, Par., 1910, 3. s., lxiii, 215-216.
- LACHAUSSE, B. I.: De hernia ventrali. In: Haller. *Disputationum chirurgicarum selectarum*, Lipsiæ, M. G. Friderici, 1721, iii, 181-211.
- LANNELONGUE, O.: Discussion. *Bull. l'acad. de méd.*, Par., 1910, 3. s., lxiii, 217.
- LEBOEUF, M. L. M.: Contribution à l'étude de la hernie épigastrique et son traitement. Thèse, Paris, 1897.
- LEPAGE, C.: Des résultats éloignés de la cure radicale des hernies épigastriques. Thèse, Paris, 1888.

- LÉVEILLÉ, J. B. F.: Nouvelle doctrine chirurgicale. Paris, J. G. Dentu, 1812, iii, 180-182; 186.
- LEWISOHN, R.: The importance of a thorough exploration of the intra-abdominal organs in operations for epigastric hernia. Surg. Gynec. & Obst., Chi., 1921, xxxii, 546-551.
- LINDENSTEIN, L.: Zur Lehre von der Hernia epigastrica. Beitr. z. klin. Chir., Tübing., 1908, lvii, 293-314.
- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- MAIGAIGNE, J. F.: Leçons cliniques sur les hernies. Paris, Germer-Baillière, 1841, p. 235-237.
- MANDL, F.: Die Hernien der Linea alba und ihre Beziehungen zu den ulzerösen Prozessen des Magens and Duodenums. Arch. f. klin. Chir., Berl., 1921, cxv, 537-561.
- MANTELLI, C.: Ernia epigastrica dello stomaco. Gior. d. r. Accad. di med. di Torino, 1913, lxxvi, 109-114.
- MENGE, K.: Zur Radikaloperation der Nabelbrüche und der epigastrischen und subumbilicalen Hernien der Linea alba. Zentralbl. f. Gynäk., Leipz., 1903, xxvii, 385-391.
- MORRIS, R. T.: Hernia of the falciform ligament. West. M. Times, Denver, 1919-1920, xxxix, 359-360.
- NAEGELI, T.: Die Hernia epigastrica und das peritonaeale Lipom der Linea alba in ihrer Bedeutung und Bewertung bei abdominalen Schmerzen und Störungen. Zentralbl. f. Chir., Leipz., 1920, xlvii, 855-857.
- NEILD, F. M.: A case of congenital suprapubic hernia. Lancet, Lond., 1920, excix, 501-502.
- PETIT, J. L.: Oeuvres complètes. Limoges, F. Chapouland, 1837, p. 610-620.
- PHILLIPS, J.: Epigastric hernia; its importance in the diagnosis of obscure abdominal conditions. Cleveland, M. J., 1913, xii, 102-108.
- PIPELET le jeune: Nouvelles observations sur les hernies de la vessie et de l'estomac. Mém. Acad. roy. de chir., Par., 1768, iv, 181-198.
- PLATNER, J. Z.: Institutiones chirurgiae rationalis. Venetiis, J. B. Albritii Hieronymi filii, 1747.
- PLOEGER, K.: Ueber die Hernia epigastrica und subperitoneale Lipome der Linea alba. I. D., Göttingen, 1899.
- POISSON, L.: Note sur la coexistence de la hernie épigastrique avec l'ulcère et le cancer de l'estomac; sa fréquence et les considérations qui en découlent. Bull. Acad. de méd., Par., 1913, 3 s. lxi, 31-34.
- PREGALDINO: Hernie épigastrique simulant un carcinome de l'estomac. Ann. Soc. belge de chir. Brux., 1896-7, iv, 302-304.
- RICHTER, A. G.: Abhandlung von den Brüchen. Göttingen, J. C. Dieterich, 1785, p. 673-681.
- ROTH: Ueber die Hernien der Linea alba. Arch. f. klin. Chir., Berl., 1891, xlii, 1-45.
- SCARPA, A.: Sull' ernia memorie anatomico-chirurgiche. Pavia, ii ed., Della stamperia Fusi e co., success, Galeazzi, 1819.
- SCHLOFFER, H.: Organische Magen und Darmerkrankungen, die sich hinter einer Hernien der Linea alba verbergen. Wien. klin. Wchnschr., 1910, xxiii, 1156-1157.
- SEBBA, M.: Beitrag zur Lehre von der Hernia Lineae albae incarcerata. Deutsche med. Wchnschr., Leipz., 1909, xxxv, 1880-1881.
- SULTAN, G.: Abdominal hernias. Transl. from the German by W. B. Coley. Phila., W. B. Saunders Co., 1902.
- TERRIER: See Berger, P.: Hernies. In: Traité de chirurgie, Duplay, S., et Reclus, P., Paris, G. Masson, 1892, vi, 796.
- THOMAN, E.: Der Magenbruch. Med. Jahrb., Wien, 1885, xv, 39-88.
- URRUTIA, L.: Hernie epigástrica y doble úlcera duodenal. Siglo méd., Madrid, 1918, lxxv, 565-566.
- VELPEAU, A. A. L. M.: Traité complet d'anatomie chirurgicale. Paris, Méquignon-Marvis, 1837, i, 36-39.
- VELPEAU, A. A. L. M.: Nouveau éléments de médecine opératoire. Paris, J. B. Baillière, 1839, iv, 232-241.
- VIALLE, J. J.: Variété rare de hernie épigastrique; hernie de la vésicule biliaire avec adhérence de son fond au collet du sac; cure radicale; guérison. Arch. méd. et pharm. mil., Par., 1903, xli, 54-59.
- VILLARD, E.: Pathogénie des hernies épigastriques. Lyon méd., 1913, cxx, 26-29.
- VOECKLER, T.: Ueber eine bisher unbeschriebene Bruchform der Linea alba (Hernia lineae albae suprapubica). Deutsche Ztschr. f. Chir., Leipz., 1912, cxvii, 582-598.
- VULPIUS, O.: Die Radikaloperation der Hernien in der vorderen Bauchwand. Beit. z. klin. Chir., Tübing., 1890, vii, 91-134.
- WALTER, C.: Hernia lineae albae supra umbilicum, quae dicitur gastrocele. I. D., Bonnæ, 1850.
- WITZEL, O.: Über den medianen Bauchbruch. Samml. klin. Vort., n. f., Leipz., 1890, p. 45-68.

ZENO, A.: Hernia epigástrica y lesiones organicas del estómago. Prensa méd. Argentina, Buenos Aires, 1914-15, i, 334-336.

LATERAL VENTRAL HERNIA

- ASSMY, P.: Ueber den Einfluss der Durchtrennung Motorischer Nerven auf die Narbenbildung bei extramedianen Bauchschnitten. *Beit. z. klin. Chir.*, Tübing, 1899, xxjii, 109-125.
- BARACZ, R.: Ein Beitrag zur Kenntniss und Actiologie der Seitlichen Bauchhernien (Pseudohernien). *Arch. f. klin. Chir.*, Berl., 1908, lxxxv, 283-301.
- BARTHÉLEMY, M.: Les hernies abdominales latérales. *Bull. et mém. Soc. de chir. de Par.*, 1919, xlv, 1313-1319.
- BARTLETT, W.: Incisional ventral hernia. *In: After-treatment of surgical patients.* St. Louis, C. V. Mosby Co., 1920, ii, 761-780.
- BEVAN, A. D.: Postoperative ventral hernia. *Surg. Clin.*, Chi. 1920, iv, 775-781.
- BEVAN, A. D.: Two cases of common duct obstruction. *Surg. Clin. N. A.*, Phila., 1922, ii, 725-735.
- BLAUDEL, C.: Zur Actiologie der seitlichen Bauchbrüche. *Beitr. z. klin. Chir.*, Tübing, 1907, liv, 229-237.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts, 2nd ed. by C. A. Key, London, Longman, Reese, Orme, Brown & Green, 1827.
- ECCLES, W. M.: Hernia, 3rd. ed., New York, W. Wood & Co., 1908.
- FERRAND, J. A. M. J.: Contribution à l'étude des hernies latérales de l'abdomen (laparocèles). Thèse, Paris, 1881.
- GIBSON, C. L.: Repair of large incisional ventral herniae by pedunculated flaps of fascia. *Ann. Surg.*, Phila., 1917, lxxv, 761-762.
- GIORDANO, D.: Contributo allo studio e cura del laparocèle. *Riforma med.*, Napoli, 1893, ix, pt. 1, 387-391.
- GRAY, H.: Anatomy. Rev. American from the 15th English ed. Phila. & N. Y., Lea Bros. & Co., 1901, p. 366-367.
- HAYNES, I. S.: The treatment of large ventral hernia by inversion of the hernial sac; with or without opening into the peritoneal sac. *N. York State J. M.*, N. Y., 1913, xiii, 630-637.
- HENSON, J. W.: A proposed addition to the technic in the radical operation for median ventral hernia where the tension on the sutures would be excessive. *Internat. J. Surg.*, N. Y., 1914, xxvii, 413-414.
- HOMANS, J.: Three hundred and eighty-five laparotomies for various diseases, with tables showing the results of operations and the subsequent history of the patients. Boston, N. Sawyer & Son, 1887.
- JUDD, E. S.: The prevention and treatment of ventral hernia. *Surg. Gynec. & Obst.*, Chi., 1912, xiv, 175-182.
- KÖNIG, F.: Die Radikaloperation grosser Hernien, besonders der Bauchbrüche, unter Verlöthung mit frei verpflanzten Periostlappen. *Beitr. z. klin. Chir.*, Tübing., 1911, lxxv, 797-811.
- LACHAUSSE, B. I.: De hernia ventrali. 1746. *In: Haller. Disputationes chirurgicae selectae.* Lausannae, Bousquet, 1755, iii, 181-211.
- LEDUAN, H. F.: Observations de chirurgie. Paris, C. Osmont, 1731, p. 57.
- LEDUAN, H. F.: Traité des operations de chirurgie. Paris, C. Osmont, 1772, 143.
- LOCKWOOD, C. B.: Hunterian lectures on the morbid anatomy, pathology, and treatment of hernia. Lond., H. K. Lewis, 1889, p. 137.
- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- MAKROCKI, F.: Beitrag zur Pathologie der Bauchdeckenbrüche mit Einschluss der sogenannten lumbarnernien. I. D., Strassburg, 1879.
- MARCY, H. O.: The anatomy and surgical treatment of hernia. New York, Appleton, 1892.
- MOLLIÈRE, D.: Note sur un cas de hernie ventrale (de la ligne semi-lunaire) étranglée et guérie par la kélotomie. *Bull. et mém. Soc. de chir.*, de Par., 1877, iii, 278-283.
- NEUHOF, H.: Fascia transplant for recurrent ventral hernia. *Ann. Surg.*, Phila., 1920, lxxi, 225-227.
- NIGST, P. F.: Zur Entstehung von Narbenhernien nach Appendektomien. *Corr.-Bl. f. Schweiz. Aerzte*, Basel, 1919, xlix, 353-359.
- OEHLECKER, F.: I. Seitlicher Bauchbruch (Pseudohernie) nach Rippenschussbruch mit Verletzung von Interkostalnerven. II. Partielle Bauchwandlähmung in ihrer Beziehung zur Thorax-chirurgie. *Deutsche Ztschr. f. Chir.*, 1920, clvi-clvii, 98-140.
- PETIT, J. L.: Hernie de l'estomac sur la ligne semi-lunaire de Spigel. *Gaz. de hôp. de Toulouse*, 1892, vi, 316-317.

- REIGNIER, A.: Essai sur les hernies ventrales. Thèse, Paris, 1879.
- ROBINSON, H. B.: Hernia through the semilunar line. *Brit. J. Surg.*, Bristol, 1914-1915, ii, 336-337.
- ROUFFART, E.: De la valeur des différentes incisions dans les laparotomies en gynécologie et en obstétrique. *Arch. mens. d'obst. et de gynéc.*, Par., 1919 viii, 577-622.
- SCHOOFS, L.: Un cas de hernie ventrale du testicle. *Arch. méd. belges*, Brux., 1895, 4 s., v, 229.
- STANTON, E. M.: Postoperative ventral hernia. *N. York State J. M.*, N. Y., 1916, xvi, 511-515.
- STÜHMER, A.: Ueber die Hernien der Bauchwand seitlich der Mittellinie unter besonderer Berücksichtigung der Hernien der Linea semilunaris Spigelii. *Beitr. z. klin. Chir.*, Tübing., 1910, lxvi, 113-135.
- THIÉVENOT, L., AND GABOURD, T.: Les hernies spontanées du repli semilunaire de Spiegel. *Rev. de chir.*, Par., 1907, xxxv, 568-585.
- TINKER, M. B.: The advantage of muscle-spitting and muscle-retraction incisions in the prevention of ventral hernia. *Illinois M. J.*, Springfield, 1905, vii, 75-82.
- VAUGHAN, R. T.: Spontaneous rupture of ventral hernia in old scar with protrusion of small bowel. *Surg. Clin.*, Chi., 1918, ii, 263-268.
- WARREN, R.: Operative treatment of umbilical and ventral hernia. *Lancet*, Lond., 1919, ii, 1048-1050.

CHAPTER XVII

DIAPHRAGMATIC HERNIA

Synonyms.—Phrenic hernia (Cooper); Thoracic hernia; Phrenoceles; Diaphragmatocele.

Definition.—A diaphragmatic hernia is a protrusion of abdominal viscera through a normal or abnormal opening in the diaphragm into the thorax.

Historical

While diaphragmatic hernia probably existed in early times with other varieties of hernias, it was never diagnosed in life, and rarely noted at autopsy. Hippocrates wrote that large openings in the diaphragm never healed. One of the earliest cases was described in 1579 by Paré, whose patient had had a penetrating wound in the chest, and had apparently recovered from it, when he developed obscure gastrointestinal symptoms and died. Autopsy showed that most of the colon had passed into the thorax through an opening the size of a finger.

Stehelinus, in 1724, called attention to the absence of external signs and the difficulty of diagnosis in traumatic diaphragmatic hernia, and he reviewed a number of cases that had been reported in the literature up to that time.

In 1761 Morgagni described diaphragmatic hernia in his treatise on pathologic anatomy. The first important study of it was made by Cooper, in 1798, and his monograph on hernia contains the account of several cases; 2 of these were his own, and the remaining number were reported by his friends. His excellent description of the anatomy and symptoms of this condition remains very valuable, and his classification of the varieties of this form of hernia is used today.

There have been many cases of diaphragmatic hernia reported. In 1880 Lacher was able to collect 276 cases in the literature. Giffin in 1912, found 650 cases, and Scudder in the same year, found records of 53 patients who had been treated by operation. Important papers on this subject have been contributed by Blum and Ombrédanne, Paillard, Waldeyer, Rauert, Leclerc, Knaggs, Keith (A.), Sailer and Rhein.

Anatomy

Congenital diaphragmatic hernia differs in several respects from that in adults, and is best explained by a brief consideration of the embryologic development of the diaphragm:

The Development of the Diaphragm.—The development of the diaphragm is customarily divided into two stages: The embryonic and the fetal. The pleural and peritoneal cavities are in direct communication with each other during the embryonic period, which terminates in the second month, when the anterior and posterior portions unite in the median line. Should this union fail to take place a hernia without a serous sac will develop; it may be complete or incomplete, and may be accompanied by other malformations.

The fetal period begins in the second month and continues until the second half of intrauterine life. The anterior and posterior portions of the diaphragm unite during this time; the peripheral muscles and the central tendon of the diaphragm develop, the posterior portion along the ribs and in the lumbar region being the last to unite. A hernia may develop at this period, owing to the absence or weakness of muscle tissue, and as the serous membranes have already formed, the hernia will have a serous sac.

The hernial opening in the embryonic type is usually on the left side and behind; this may be due to the fact that the right side of the diaphragm develops earlier than the left side, and because the openings for the aorta and esophagus are a little to the left. Of 122 cases collected from the literature by Paillard, the opening was on the left side in 94, and on the right side in 26. The foramen of Bochdalek is found between the two nonunited portions of the diaphragm, the septum transversum and the mass of the pillars, and is usually crescentic in shape.

In the fetal type, the hernial opening has no fixed location; the defect may be anywhere in the diaphragm. It is usually on one side; sometimes it is in front and rarely there may be more than one opening. The opening may be circular or oblong in shape, if the hernia is due to deficient development. The orifice is covered by two layers, the peritoneum and the serous membrane of the pleura, which form the hernial sac.

The early development of the liver prevents congenital hernia from appearing more frequently on the right side; in the case reported by Riggs, the opening was between the right and left lobes of the liver which were widely separated.

Hernia Through the Normal Openings.—Congenital hernia may rarely occur through the normal openings of the diaphragm for the esophagus, aorta or vena cava; of the three, the hernia most often traverses the esophageal opening.

Acquired Diaphragmatic Hernia.—Acquired diaphragmatic hernia may occur through the foramen of Bochdalek, which is crescent-shaped and is bounded in front by the converging fibers of the diaphragm; behind by the quadratus lumborum; at the inner side by fascia, which is inserted into the transverse process of the second lumbar vertebra; and at the outer side by fascia which is inserted into the twelfth rib. These hernias can also come through the parasternal orifice or foramen of Morgagni, which is the inter-

val between the tendinous fibers from the ensiform cartilage and the cartilages of the adjoining ribs. This is a normal weak point in the diaphragm, and is always very narrow, except when the insertion into the seventh rib is deficient. These hernias may also break through a triangular opening which sometimes exists between the fibers arising from the internal and external

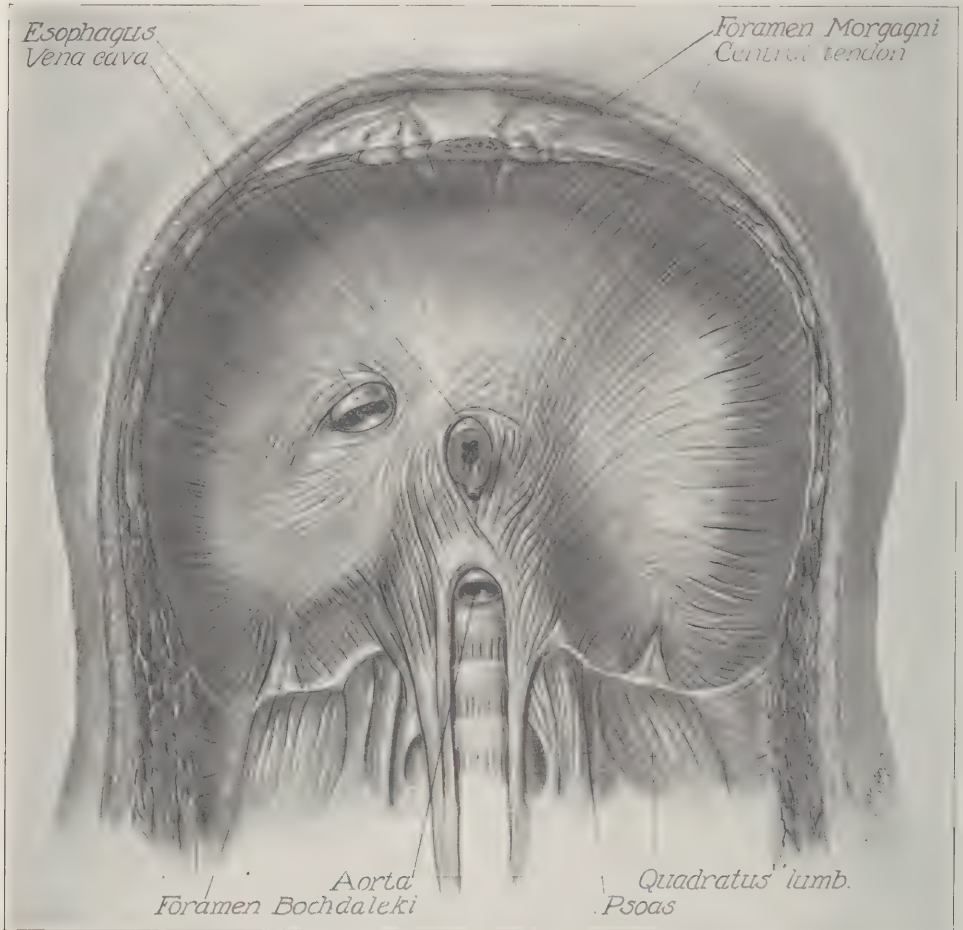


Fig. 156.—The normal and acquired openings in the diaphragm. Congenital hernia rarely occurs through the normal openings in the diaphragm for the esophagus, aorta, or vena cava. Acquired diaphragmatic hernia may occur through the foramen of Bochdalek, the foramen of Morgagni, between the internal and external arcuate ligaments, or through abnormal openings in the diaphragm itself.

arcuate ligaments. They also may enter the thorax through abnormal or buttonhole openings in the diaphragmatic muscle itself, either near the center or at the edge. (Fig. 156.)

Traumatic hernias occur anywhere in the diaphragm and take the form of the instrument causing the wound, as in cases where hernia follows a

bullet or a stab wound. If the cause is a crushing injury, the hernia usually breaks through at one of the weak points.

Course of the Hernia.—The hernia usually occurs through the lateral portion of the diaphragm and enters the thoracic cavity; sometimes it passes through the central tendon of the diaphragm and enters the pericardial cavity.

Elevation of the Diaphragm.—Petit, in 1790, used the term *eventratio diaphragmatica* to describe a unilateral relaxation of the diaphragm, which is usually due to paralysis. Giffin, in 1912, suggested that the term, "elevation of the diaphragm," describes the condition more accurately. (Elevation of the diaphragm is not a hernia, and the only reason it is considered here is because of its frequent confusion with hernia.)

Bayne-Jones, in 1916, collected 45 cases from the literature; only 3 of these were on the right side. He reports an additional case of his own, also occurring on the right side, which is the first one to be diagnosed during life.

Frequency of the Varieties.—In 433 cases collected from the literature by Murray and Morgan, 232 were congenital, 181 acquired, and in the remaining number the variety was not stated.

Congenital diaphragmatic hernia is about 8 times more frequent on the left side than on the right.

The Hernial Sac.—The hernial sac is composed of one or two layers of serous membrane. When there is one layer, it consists of the parietal membrane of the pleura, which is very thin and may be adherent to other structures; when there are two layers, the sac is usually firm and well defined, and it is often impossible to separate the peritoneal and pleural layers, especially at the sides. Sometimes a thin layer of fat lies between the two membranes at the fundus of the sac.

In a majority of the cases the sac is absent. In 276 cases collected by Lacher, the sac was present in 28.

True and False Sacs.—Some writers have classified diaphragmatic hernia according to the presence or absence of the sac, calling those with a sac "true" diaphragmatic hernia, and those without a sac "false" diaphragmatic hernia. Either of these varieties may be congenital or acquired, while the traumatic hernia is without a sac at all times. (Figs. 157 and 158.)

Contents of the Sac.—All of the abdominal viscera have been found in the pleural cavity. In the order of frequency they are: The stomach, liver, intestine, colon, duodenum, pancreas, appendix and kidneys; several of these organs may be found together. In the case observed by Vogel, omentum, stomach, transverse and descending colon, cecum, appendix, and small intestine were found.

a. *The Stomach.*—The stomach may be wholly or partially within the hernia. A portion of the stomach wall may be caught in the hernial ring, a condition that Knaggs has compared to a Richter's hernia; a diverticulum

of the stomach may be in the hernia or ulcers may form, even perforating in the herniated portion. Reischauer has reported a case of carcinoma of the stomach in a diaphragmatic hernia.

b. *The Large Intestine.*—The transverse colon is most often found in the hernia; the descending colon is next in frequency, and the ascending colon is most seldom present.

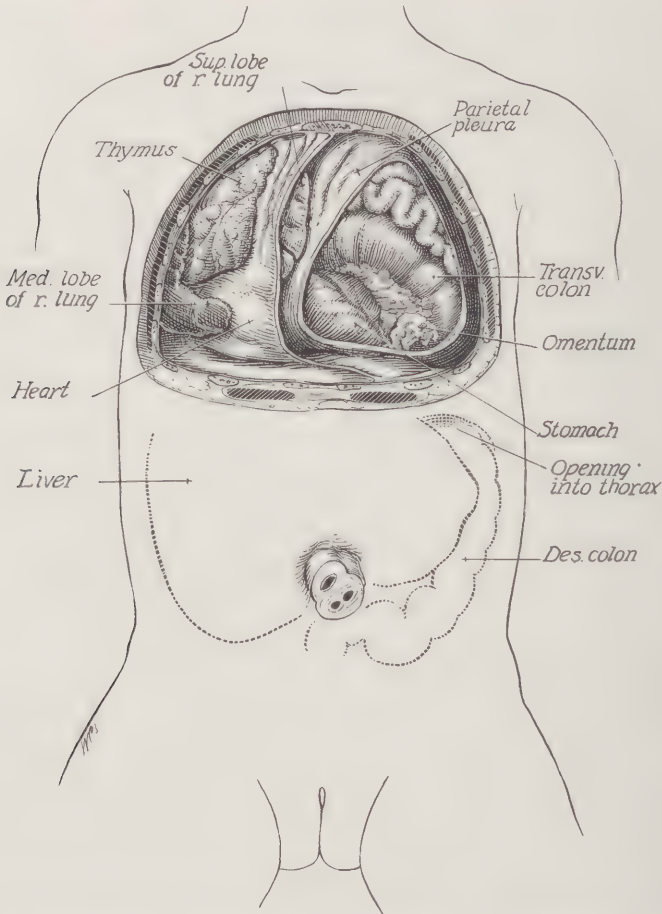


Fig. 157.—True diaphragmatic hernia. This variety of hernia always has a sac, and is usually congenital.

c. *The Small Intestine.*—If the hernia is large, there may be several loops of the small intestine in it. In rare instances nearly all of the small intestine is in the sac.

d. *Omentum.*—Omentum may be found alone in the hernia, but it is more often associated with the stomach or the small or large intestine. It has a tendency to become adherent to the sac and the other contents, and may result in the hernia becoming irreducible or even strangulated.

e. *The Liver.*—The liver is rarely alone in the hernial mass; the whole

of it or only one lobe may be present. If the diaphragmatic opening is very large, the liver may pass back and forth through the orifice with each respiration. When only one lobe is in the hernia, it is usually the right one.

f. *The Spleen*.—The spleen is seldom found alone in the hernia, usually being associated with the stomach.

g. *The Kidney*.—Diaphragmatic hernia of the kidney is very rare.

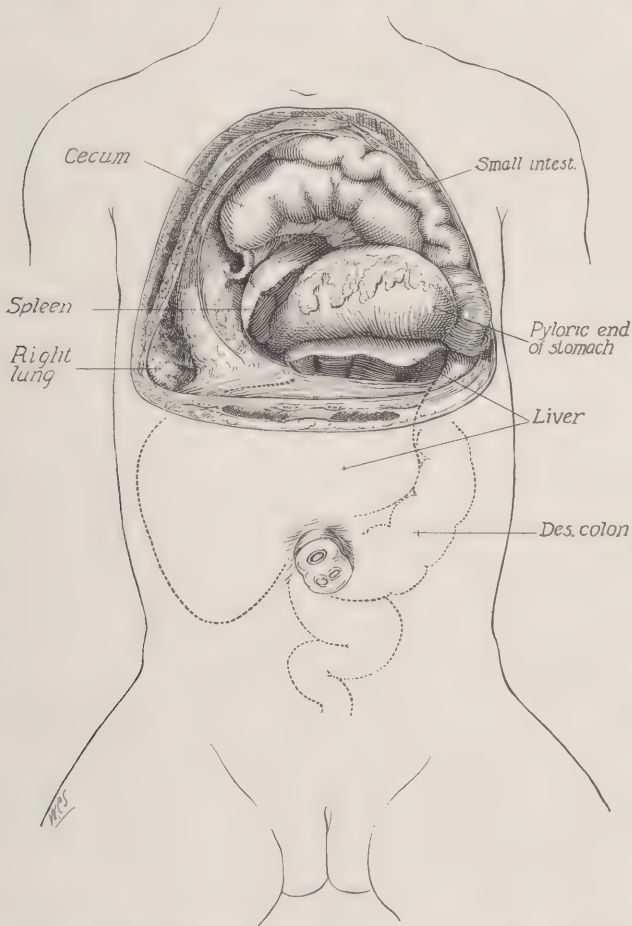


Fig. 158.—False diaphragmatic hernia. This variety of hernia has no sac, and may be either congenital or acquired. Traumatic hernia is of this type and consequently never has a sac.

Spencer saw a case; and Chambrelent and Princeteau collected 4 cases from the literature. The left kidney is more often found in the hernia than the right one.

The Thoracic Organs.—The shape of the thoracic viscera is modified by the pressure of the hernia. In small and medium-sized hernias, the lungs are only slightly displaced and breathing is not greatly interfered with; in large ones, the pressure may be so great as to cause congestion and emphysema,

and the heart may be displaced backwards and upwards with symptoms of pressure. In Pozzi's case, the lungs were greatly reduced in size and were the shape of a tongue, and the heart was adherent to the clavicle. When the hernia is on the right side there is little or no change in the position of the heart, but when it is on the left side, the displacement of the heart is usually marked. Mitchell saw a case of hernia on the left side with the heart displaced two and a half inches (6.25 cm.) to the right of the sternum.

Other Congenital Malformations.—Other congenital malformations are also associated with diaphragmatic hernia, such as harelip, cleft palate, absence of kidney, hydrocephalus, etc. In 130 cases of congenital diaphragmatic hernia, collected in the literature by Paillard, 15 patients had other malformations. Taylor and Lindsay saw a case of transposition of viscera associated with diaphragmatic hernia.

Etiology

In the past there has been considerable controversy over the cause of diaphragmatic hernia. Cruveilhier divided these hernias into the congenital and acquired varieties, and this classification was adopted by Lacher. I think they are more accurately described by the grouping originally proposed by Cooper, namely, congenital, acquired, and traumatic.

1. Congenital Diaphragmatic Hernia.—The embryology of congenital diaphragmatic hernia has already been considered. Malformations may be present at birth, but the hernia may not be forced through the diaphragmatic opening until later in life; or it is possible for a small hernia to pass through a defect in the diaphragm and remain unnoticed, until a trauma causes it to increase in size.

To determine whether or not the hernia is of congenital origin, the site of the opening must be considered; the presence or absence of other malformations must be noted; and the formation of the sac studied, if there is one. (These points have been discussed at length under anatomy.) I believe that almost all hernias in adults that are customarily diagnosed as "congenital" are in reality traumatic.

2. Acquired Diaphragmatic Hernia.—Acquired diaphragmatic hernia appears through one of the normal openings in the diaphragm; the esophageal, aortic, splanchnic or vena cava. It almost always occurs at the esophageal opening, as this is the weakest point in the diaphragm. (Fig. 159.) Protrusions through the aortic, splanchnic and vena cava openings are very rare. Platner reported a case through the aortic opening.

As in direct inguinal and acquired lumbar hernias, the acquired variety of diaphragmatic hernia follows indirect injury, strains, such as lifting and coughing, or a fall. Other factors that may favor it are obesity, emaciation,

chronic bronchitis, and laborious occupations. In Greiwe's case, in a girl five and a half years old, the symptoms appeared soon after birth, following an attack of whooping cough.

3. Traumatic Diaphragmatic Hernia.—Traumatic diaphragmatic hernia usually occurs in adults and is most often found in men. It includes all hernias due to injury of the diaphragm. The injury may be direct, such as from a blow, a bullet or stab wound. Blum and Ombrédanne collected 9 cases following fracture of a rib. It may be indirect, due to a crushing injury, or any trauma that increases intraabdominal pressure sufficiently to rupture the

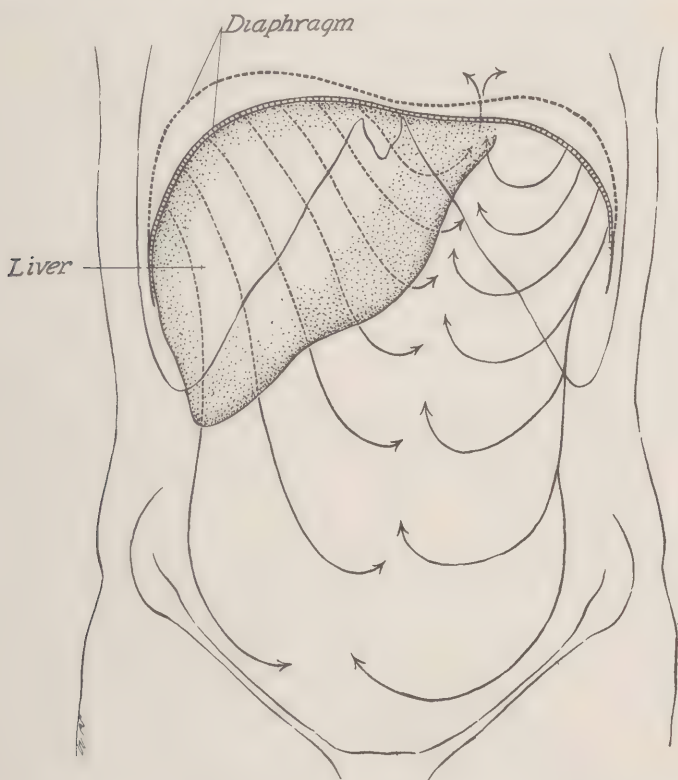


Fig. 159.—The effects of increased intraabdominal tension. When acquired diaphragmatic hernia follows a sudden increase in intraabdominal tension, such as is caused by an indirect injury, strain, or fall, it nearly always occurs at the esophageal opening, which is the weakest point in the diaphragm.

diaphragm. Weakening of the diaphragm due to disease, such as follows malignancy, empyema and subphrenic abscess, is a predisposing cause. (Fig. 160.)

Some writers believe that traumatic diaphragmatic hernia should be classified as an eventration, just as a protrusion of viscera through the abdominal wall is called a ventral eventration. I believe it is best to retain the term "traumatic diaphragmatic hernia" to designate those hernias due

to injury, and use the word *eventration* only to describe elevation of the diaphragm, or the *eventratio diaphragmatica* of Petit and Thoma.

Macmillan states that in 15,000 patients examined with the roentgen-ray at General Hospital No. 1, only three cases of diaphragmatic hernia were found. Two of these patients had received chest wounds, and the third had had an operation for empyema.

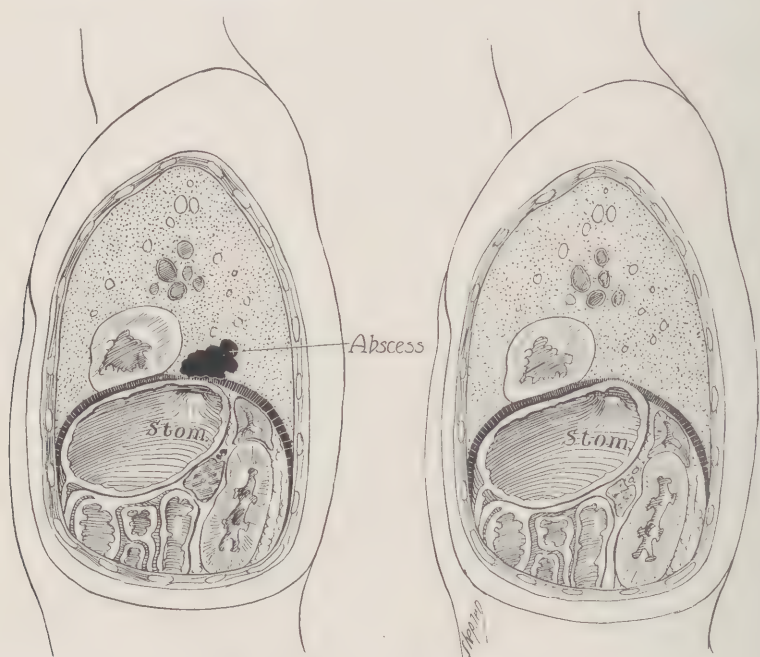


Fig. 160.—Subphrenic abscess. This disease often weakens the diaphragm, thus favoring diaphragmatic hernia.

Symptoms and Diagnosis

The symptoms of diaphragmatic hernia are often indefinite, and it is only since the advent of the roentgen-ray examination that it has been possible to diagnose the condition accurately during life. If the hernial opening is very large, both stomach and colon may be in the chest, and as long as they can empty readily, the condition may not be suspected. Mercadé saw a soldier who had had a congenital diaphragmatic hernia for 27 years without symptoms. A bullet penetrated the greater curvature of the stomach, which was in the chest, and caused a fatal pleuritis. Panzer reported the case of a patient who suddenly complained of intense pain in the chest, and died a few minutes later. Autopsy showed an opening in the diaphragm as large as a fist, with omentum, spleen and stomach in the thorax; there was no history of trauma.

It is most satisfactory to consider, first, the symptoms, which may be

either pulmonary, or referred to the digestive tract and next the physical signs:

1. **Functional Symptoms.**—(a) *Pulmonary Symptoms.*—The pulmonary symptoms are: Dyspnea, which may be slight, or so severe as to prevent the patient from lying down; pressure on the heart, which is manifested by syncope, irregularity, and cyanosis; hiccoughs may be persistent.

In a number of cases found in the literature, the pain has radiated to the shoulder and down the arm, or along the upper border of the trapezius muscle, as in the case observed by Carson and Huelsmann. The patient may complain of pain behind the sternum or at the sides of the thorax, which is aggravated by pressure and by lying down. Epigastric pain is usually increased by pressure; in Cranwell's patient it was increased by deep inspiration and coughing.

Relief is often experienced by change in position, or by lying on the unaffected side. Symonds' patient suffered from a dull continuous pain, which was aggravated by constipation, and was partially relieved by assuming a crouching position. Vitrac's patient was relieved of pain by sitting down and flexing the body strongly forward.

b. *Digestive Symptoms.*—Difficulty in swallowing is infrequent. Epigastric pain and digestive disturbances are often complained of. The pain may be severe and is sometimes described as burning, or cutting in character; it may be colicky, and if severe enough, will cause nausea and vomiting. It usually comes on after meals and may be caused by small quantities of liquid food, and is very severe following solid food. The patient may complain of food lodging in the chest where it causes a fixed pain. At other times, a gurgling or rumbling sound may be heard in the chest.

Sometimes temporary relief follows the use of a strong cathartic. Occasionally hernias of a small portion of the stomach are relieved by eating; this is due to the drawing downward of the herniated portion of the stomach, by the weight of food. If only omentum is in the hernia, the symptoms are slight and indefinite, consisting of indigestion and epigastric discomfort.

2. **The Physical Signs.**—The physical signs are often as vague as the subjective symptoms. Litten's sign, which is a movable horizontal depression on the lower part of the side of the thorax, seen during respiration, is usually absent on the affected side. A depression may rarely be seen in the epigastric and left hypochondriac regions, with a corresponding fullness over the lower part of the thorax. Auscultation over the lung on the affected side may elicit a feeble vesicular murmur—sometimes even this will be absent. The respiratory sounds may not be audible at the base of the lung, but will be normal at the apex, and are usually lessened with the patient in the knee-chest position. Percussion will reveal a displacement of cardiac dullness, usually to the right, and the lower part of the thorax will give a resonant sound if the hernia contains empty stomach and intestine; a dull

sound will be obtained if solid viscera are in the hernia, or if the herniated stomach and intestine contain fluid. If the hernia contains hollow viscera, abnormal sounds, such as gurgling, splashing, metallic tinklings and borborygmus may be heard.

3. Diaphragmatic Hernia in the Newly Born.—Congenital diaphragmatic hernia in infants presents no characteristic symptoms. There is usually a marked cyanosis and great difficulty in breathing, and as a rule, death occurs in a few hours. In 57 cases collected from the literature by Funck-Brentano, 51 patients died within the first 24 hours.

The efforts of the older surgeons to diagnose the condition were interesting and ingenious, and although dangerous, are worth remembering, when diagnosis has to be made without the aid of the roentgen-ray, which is our most reliable means at the present time. Some recommended auscultation, after the patient had taken food or had drunk an abundance of water. Leichtenstern inflated the stomach through an esophageal tube, and by auscultation he could hear a whistling sound in the thorax, and the patient's breathing became embarrassed. Other surgeons inflated the stomach with an effervescent powder before examining the hernia, and if hernia of the transverse colon was suspected, they inflated the tumor by injecting air through the rectum.

4. Roentgen-Ray Diagnosis.—The roentgen-ray represents the most important means of diagnosis in nonstrangulated diaphragmatic hernia. The routine use of this method in gastrointestinal examination has resulted in the discovery of many unsuspected or symptomless hernias of the diaphragm.

While it is often possible to recognize a diaphragmatic hernia by simple fluoroscopic examination, it is always advisable to examine the patient after a preliminary opaque meal or enema before making a diagnosis. The patient should be examined in both the standing and reclining postures.

a. Examination Without Opaque Meal. Fluoroscopic examination will show loss of the normal bow-line of the diaphragm on the side of the hernia, which is usually on the left involving the stomach. The air bubble of the stomach is absent, and a part of the stomach or all of it may be visible above the diaphragm. When several viscera are in the hernia there may be a number of rainbow-like lines cast by the rounding tops of the air bubbles in the different organs. The curving-in of the sides of the stomach, due to the constriction of the hernial ring, is a valuable sign, and is best seen with the patient in the standing position. There is retraction and elevation of the lung on the affected side, and lung tissue can be seen through the gas bubble. The heart may be displaced to one side, or its position may be influenced by the fullness of the stomach or colon in the hernia.

b. Examination with Opaque Meal. On account of the toxic symptoms that sometimes follow the use of bismuth, it has been generally replaced by barium for gastroenterologic roentgen-ray examinations. The preliminary

opaque meal consists of barium sulphate emulsified in buttermilk, or other suitable liquid, 12 to 16 ounces (350 to 500 c.c. or mls) usually being sufficient. This may have to be drunk very slowly on account of the pain and pressure symptoms. If the solution is cold, there is less tendency to nausea and vomiting.

The examination should always be made by the fluoroscope, as by this means it is possible to recognize small hernias that are liable to escape detection by the plate method, (unless a series of plates are made, with the patient lying down, and the pelvis raised); the barium will be seen to enter the portion of the stomach above the diaphragm, and a little later it will reach the duodenum. If the presence of colon in the hernia is suspected, the opaque meal must be watched at intervals until it passes the splenic flexure, or the barium can be given by enema, at a second examination. (Figs. 161, 162, and 163.) The viscera in the hernia are usually most apparent with the patient in the reclining position. The constriction of the stomach by the

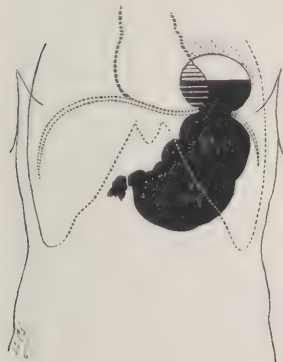


Fig. 161.

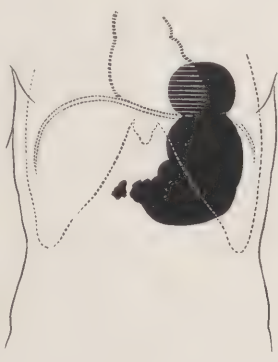


Fig. 162.

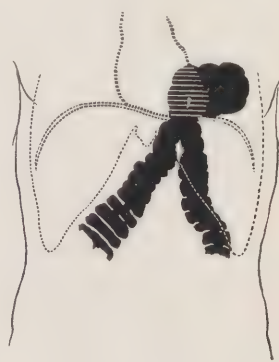


Fig. 163.

Roentgen-ray examination.

Fig. 161.—Hour-glass appearance of the stomach and "air-bell" in thorax, with patient in standing position.

Fig. 162.—Disappearance of "air-bell" with patient in prone position.

Fig. 163.—Splenic flexure in thorax.

hernial ring should not be mistaken for an hour-glass contraction of the stomach. It is also well to examine the patient as he lies on his side, so that the barium line will be at a right angle to the bow line of the diaphragm. A good idea of the reducibility of the hernia and the extent of pleural or pericardial adhesions can be obtained by examining the patient in different positions.

5. Complications.—a. *Strangulated Diaphragmatic Hernia.*—The transverse colon is most often strangulated; the stomach is next in frequency, and rarely the small intestine is strangulated. The condition usually follows a sudden strain, or trauma which forces a considerable quantity of viscera through the opening into the thorax. The general symptoms of strangulation in diaphragmatic hernia are similar to those in other varieties of hernia.

The pain is sudden, severe, and localized in the epigastric region. There is profound shock, dyspnea is very marked, the diaphragm is immobilized, and respiration is of the superior costal type. The signs of obstruction depend on the viscus that is strangulated. Tuley has reported a case in which the stomach and colon were strangulated. Foster saw a case in which the stomach and most of the small intestine were in the hernia, and a torsion of the mass had caused a volvulus in the mid-portion of the ileum that resulted in secondary gangrene of 24 inches (60 cm.) of the small intestine. An unusual case has been reported by Slater and Mackenzie. A man received a war wound in 1917, and no symptoms of any kind appeared until 4 years later when a small portion of the transverse colon passed through the opening into the thorax and became obstructed.

b. *Rupture of Viscera in the Hernia.*—Rupture of the abdominal viscera contained in the hernia is an unusual complication. The stomach is ruptured most often; the liver and spleen less frequently; and the intestine and colon, very rarely.

c. *Other Complications.*—Wounds of the thorax and abdomen may complicate diaphragmatic hernia. In the case reported by Prat, omentum protruded through a left lumbo-thoracic wound. The omentum was resected and the wound dressed. (There were no symptoms of diaphragmatic hernia.) Peritonitis developed, the patient died, and at autopsy the stomach was found in the thorax.

There are a number of cases recorded in the literature in which the patient has been operated on for stomach trouble, gall-stones or appendicitis, and the diaphragmatic hernia was left undiscovered until a subsequent operation for unrelieved symptoms, or at autopsy. Routine examination of the diaphragm, as well as other hernial openings, should be the rule in every laparotomy with obscure symptoms of intestinal obstruction. In traumatic diaphragmatic hernia rupture of intraabdominal viscera may also occur.

Differential Diagnosis

Diaphragmatic hernia may occur with hernia in other regions, and it must not be mistaken for the following conditions:

1. *Pneumothorax.*—In pneumothorax there are no subjective symptoms of hernia, and no intestinal or stomach sounds can be heard in the thorax. Roentgen-ray examination shows an abnormal clearness corresponding to the air in the pleural cavity, and the stomach and intestines are seen below the diaphragm. If a hernia is mistaken for a pneumothorax, and aspirated the result may be fatal. In the case reported by Ringrose, 6 ounces of black fluid was aspirated; at autopsy the stomach was found in the thorax.

2. *Fluid in the Thoracic Cavity.*—The thoracic cavity may contain a colorless fluid, blood or pus. The symptoms are similar to those of pneumothorax; except when there is empyema there will be chills, fever, and other

symptoms of sepsis. Roentgen-ray examination easily excludes hernia. In Mereadé's patient, who had a bullet wound through the stomach in the chest, the symptoms of perforation were treated for a hemothorax.

3. *Injury of Other Viscera.*—In traumatic hernia, the heart, lungs, pleura and the nonherniated abdominal viscera may be injured; there may be hemorrhage from severed blood vessels, and also peritonitis if the stomach or intestines have been ruptured. These complications may make diagnosis impossible before operation.

4. *Elevation of the Diaphragm.*—Elevation of the diaphragm is difficult to differentiate from diaphragmatic hernia. According to Giffin, the three most important signs of diaphragmatic hernia are a destruction of the definite dome-shape of the normal diaphragm line; the appearance of lung tissue through the gas bubble in the chest; and the demonstration of the colon above the bow line of the diaphragm. These symptoms are lacking in elevation of the diaphragm.

Keith (D. Y.) gives the following roentgen-ray table for differential diagnosis:

EVENTRATION	HERNIA
High dome of the diaphragm with no loss of contour.	High diaphragm with loss of contour, a portion being regular, and a portion blurred.
No gas shadows above liver shadow.	Gas or barium shadow seen above liver shadow.
More likely to be congenital.	Gastric deformity.
Paradoxical movement of the diaphragm.	Obstruction.
	Presence of gas or fluid, or both, in the hernial sac.

5. *Diverticulum of Esophagus.*—Small diverticula of the lower end of the esophagus may be mistaken for diaphragmatic hernia of the stomach at roentgenologic examination; this mistake has been made by experienced radiologists.

Prognosis

The course of diaphragmatic hernia is progressive. The symptoms, often mild at first, tend to increase in severity as the hernia grows larger, and sudden strangulation is the eventual termination of untreated cases.

There is no palliative treatment. All the patient can do is to follow a restricted diet, and avoid all forms of physical exertion, to lessen the danger of strangulation. When there are nausea and vomiting, cold food is tolerated best. Liquids and soft foods cause less pain than solid or coarse foods. Mathews' and Imboden's patient with hernia of the stomach, experienced the least discomfort from a diet of a small quantity of meat, potatoes and eggs; the symptoms were aggravated by soups, desserts and green vegetables.

Because of the obscure symptoms, this disease is often not suspected, consequently operation is not undertaken at the most favorable time. The outlook is always grave; however, roentgen-ray examination makes an early

diagnosis possible, and prompt operation has reduced the mortality of strangulated and traumatic hernia 50 per cent.

Mortality in the newly born is very high; there is usually no treatment for them, and 90 per cent die within the first 24 hours.

Treatment

It is only in recent years, with the improved methods of diagnosis, that nonstrangulated diaphragmatic hernia has been recognized early and treated by operation, resulting in the development of a successful surgical technic. Scudder found only 53 patients reported in the literature, who had come to operation previous to 1912; while a recent search shows that nearly an equal number were operated on between 1912 and 1923.

On account of the severity of the symptoms and the dangers of strangu-

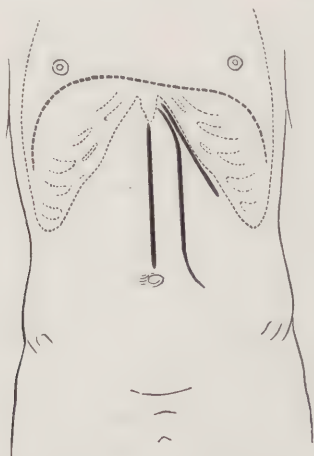


Fig. 164.—The abdominal incisions for diaphragmatic hernia. The abdomen is opened by an incision above the umbilicus in the midline, or by a lateral rectus incision, or by one of the gall-bladder incisions. The Bevan S-incision is one of the best.

lation, the radical operation by the abdominal route is the treatment of choice. The thoracic route is preferred by a minority of surgeons. When it is impossible to reduce the hernia from the abdominal side, it is necessary to make use of both incisions.

1. The Abdominal Route.—The abdominal route is indicated when there has been injury to abdominal viscera and when there are symptoms of intestinal obstruction. It enables the operator to confirm the diagnosis promptly and in case intestinal resection is necessary, it affords the better exposure and permits a quicker repair. The patient suffers less from shock following laparotomy than after thoracotomy.

a. The Operation.—The patient is placed in the Trendelenburg position and the abdomen opened by an incision above the umbilicus in the mid-line, or by a lateral rectus incision, or by one of the gall-bladder incisions. A

free exposure is essential, and it is often advisable to carry the incision one or two inches (2.5 to 5 cm.) below the umbilicus. (Fig. 164.)

On opening the abdomen, the operator will immediately notice that certain of the viscera are not in their normal position; the organs most fre-

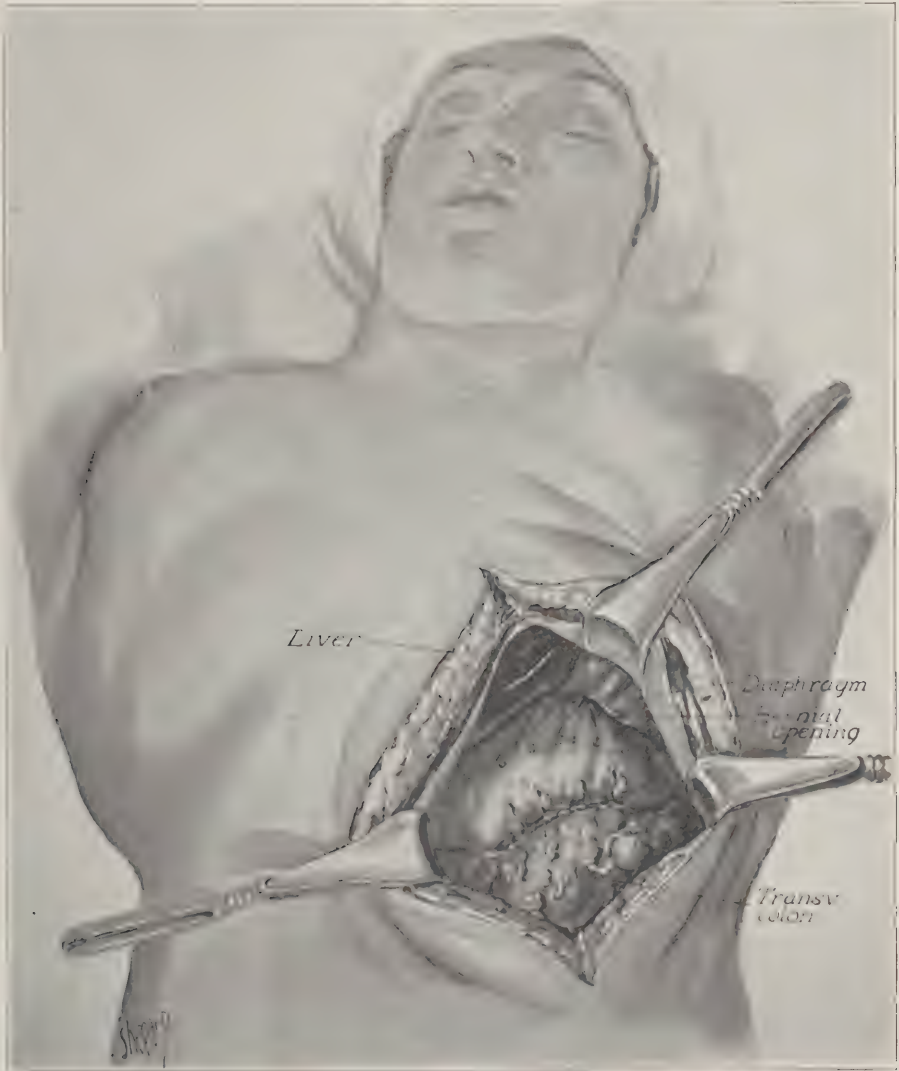


Fig. 165.—The abdominal operation for diaphragmatic hernia. On opening the abdomen certain viscera are not in their normal position. On investigation an opening is found in the diaphragm, and some of the abdominal viscera are found in the thorax.

quently herniated are the stomach, transverse colon and small intestine. (Fig. 165.) With the patient thoroughly relaxed under general anesthesia, the hernial opening in the diaphragm is exposed by wide retraction, and the hernia reduced by grasping the portion of viscera still within the abdomen and mak-

ing gentle traction on it; reduction may possibly be facilitated by placing the patient in a vertical position. If reduction cannot be accomplished, the hernial opening can be enlarged; this failing, it is necessary to open the thoracic cavity, free the adhesions and reduce the hernia. In Scudder's patient, a stomach tube was passed and the viscus emptied by compressing it in the chest; the hernia was then reduced without difficulty.

The principal disadvantages of the abdominal route are, the depth of the hernial opening, the impossibility of freeing extensive adhesions in the thorax, and the difficulty of preventing the viscus in the hernia from being drawn back into the chest with each inspiration.

The method of closure of the diaphragmatic opening depends on its size

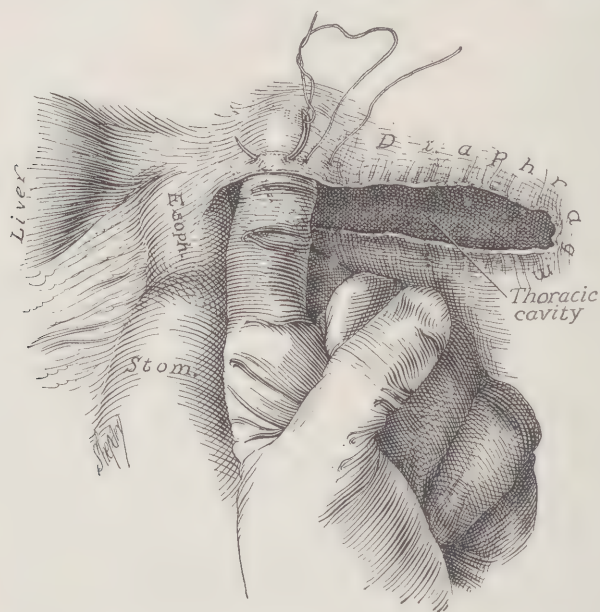


Fig. 166.—Closing the opening in the diaphragm. It is important that each stitch takes a deep bite into the muscle, which is pulled down by the forefinger.

and location. If the edges of the opening can be brought together, the hernia can be closed with interrupted or mattress sutures of heavy chromic catgut, taking a deep bite in the muscle with each stitch; this closure can be reinforced by a second layer of sutures, either continuous or interrupted. (Figs. 166, 167, and 168.) Soresi closes these openings by taking a number of stitches on each side, parallel to the edge of the opening; these stitches are tied together on each side and then tied across, leaving a small opening at each end to be closed by pursestring sutures. This method secures an overlapping of the edges of the wound. (Fig. 169.)

If drainage of the pleural cavity is necessary, it can be secured by making a stab wound, with a sharp-pointed hemostat, passed through the

diaphragmatic opening and through the posterior part of the chest wall between the ribs, at the lowest point of the pleura. The line of suture of the diaphragm is often reenforced by sewing a strip of fascia, or a portion of the omentum or stomach, which has been in the hernia, to the edges of the opening. (Fig. 170.)

Balfour closed the defect by using a long continuous suture of No. 2 chromic catgut, beginning at the anterior part of the opening, which was

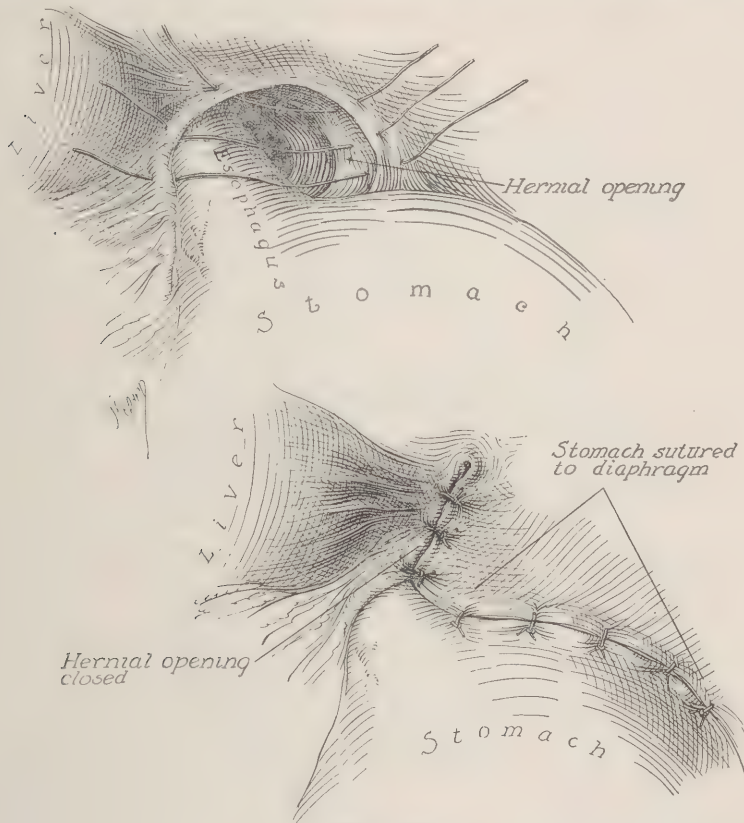


Fig. 167.

Fig. 168.

Closing the opening in the diaphragm.

Fig. 167.—When the esophageal opening is small, the edges of the diaphragm can be readily brought together and stitched with interrupted or mattress sutures of heavy chromicized catgut.

Fig. 168.—The sutures in the diaphragm have been tied. To lessen the danger of recurrence, the wall of the stomach is anchored to the diaphragm.

most accessible, and approximating the edges with the aid of traction forceps. After closing two-thirds of the gap, the difficult posterior one-third was easily closed by picking up the most distant edge of the remaining opening and suturing on a line at a right angle to the first line of suture. This approximated and slightly overlapped the edges with the least amount

of tension. A layer of interrupted reenforcing sutures was placed over the first line of closure. (Fig. 171.)

If the hernia cannot be reduced, and the condition of the patient does not permit opening the thorax, a gastrojejunostomy can be done; if the transverse colon is in the hernia, the ascending and the descending colon can be anastomosed.

2. Thoracic Route.—The thoracic operation should be used when there is traumatic injury of the pleura, lungs, heart or blood vessels, accompanied

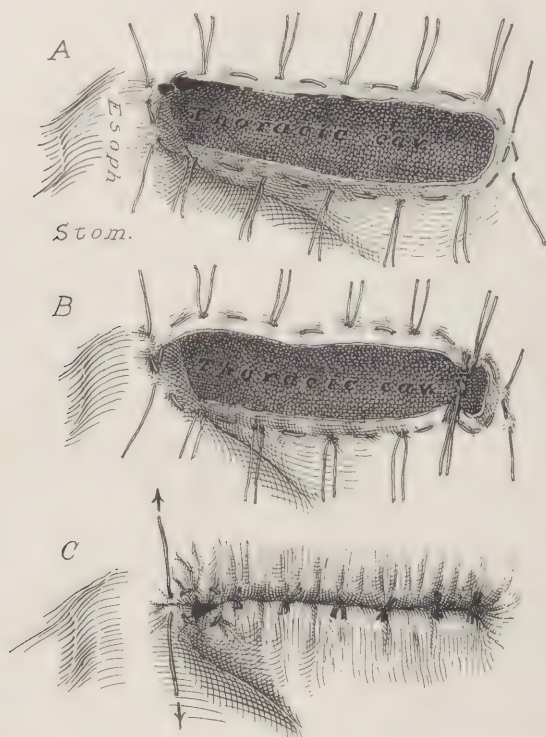


Fig. 169.—Soresi's method for closing the opening in the diaphragm. A number of stitches are taken on each side parallel with the edge of the opening; these sutures are tied together on each side and then tied across, leaving a small opening at each end to be closed by a pursestring suture.

by hemorrhage. The wound in the chest acts as a guide down to the hernia, which can be freely exposed simply by enlarging the wound. (Figs. 172 and 173.)

The advantages of the thoracic route are: It is easier to deal with the hernia because it is nearer the surface than when approached from the abdomen; the hernia can be more readily reduced, and the adhesions to the pleura and pericardium can be freed; and it is less difficult to close the hernial opening. If gangrene has already occurred, the thoracic route should be used first, because of the chance of perforation having occurred, and the

danger of tearing the viscera in reducing the hernia. The abdominal viscera should be examined and treated through a laparotomy incision.

a. *The Operation.*—The patient is usually placed on the table in a lateral position. The intercostal space is widened by means of a pillow or sand bag under the chest. The incision is made in the 8th or 9th intercostal space and is 4 to 5 inches (10 to 12.5 cm.) in length. Strong retraction is made and the ribs widely separated; it is usually possible by this means to avoid the resection of one or more ribs. If the exposure is insufficient, it is necessary to resect the costal arch.

A number of methods of thoracotomy have been described. Postempski

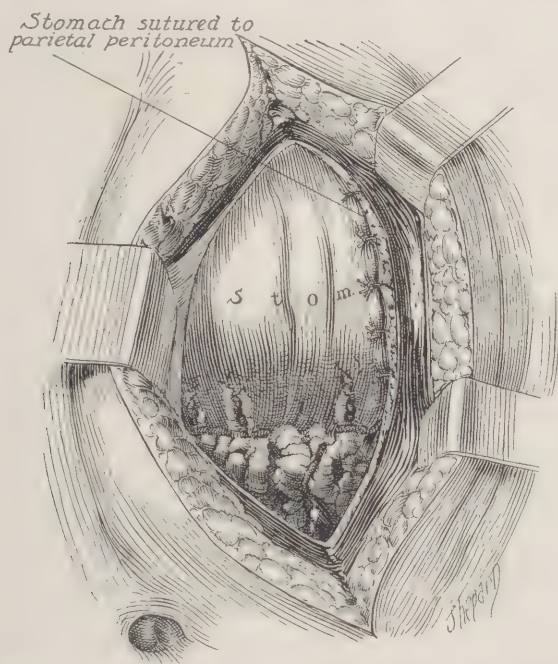


Fig. 170.—Closing the opening in the diaphragm. When the esophageal opening in the diaphragm cannot be completely closed, recurrence may be prevented by suturing the stomach to the peritoneum of the abdominal incision.

made a U-shaped flap, with the base upward, dividing two to four ribs in two places. Graser resected about four inches (10 cm.) of the rib immediately beneath the wound. In hernias through the anterior part of the diaphragm occurring in children or young people, in whom the chest wall is still elastic, Rydygier cut through the ribs on the outer side and turned up a flap, using the costal cartilages as a hinge. Cranwell obtained an excellent exposure of the hernia by turning up a flap and resecting four inches (10 cm.) of the 8th and 9th ribs.

I believe that the best exposure is obtained by an incision which begins at the lower edge of the rib at the end of the xiphoid cartilage, divides the

rectus muscle, and enters the intercostal space between the 9th and 10th ribs without opening the pleura. (Figs. 174 and 175.)

The hernia is reduced, the excess of sac is folded upon itself and used as a pad to close the opening, or the sac can be resected and the edges overlapped and sutured. The edges of the hernial opening are brought to-

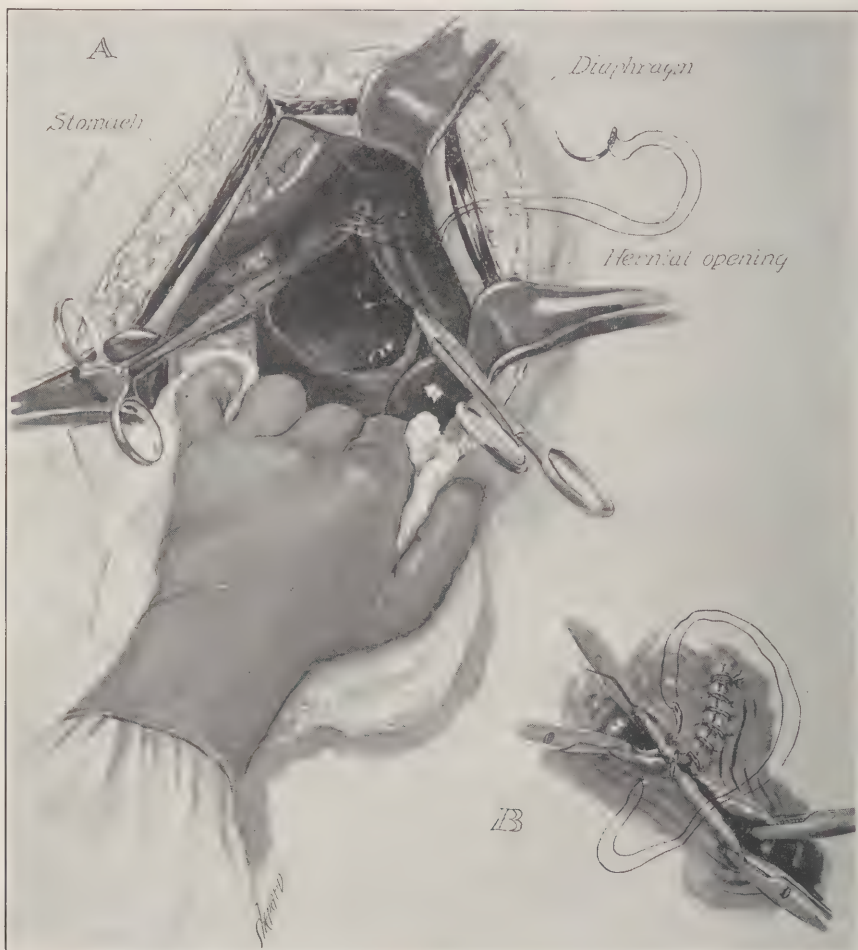


Fig. 171.—Closing the opening in the diaphragm. (a) In closing a large opening, the edges of the anterior part, which are most accessible, are approximated with the aid of traction forceps, and the anterior two-thirds of the defect closed with a long continuous suture. (b) The posterior one-third is then easily closed by picking up the most distant edge of the remaining opening, and suturing on a line at a right angle to the first suture line.

gether by interrupted sutures of heavy chromic catgut, or one of the methods of closure described under the abdominal operation can be used here.

To quiet the diaphragm while suturing the hernial opening, Helsted advises blocking the phrenic nerve on the side of the hernia. This procedure will keep the diaphragm quiet for several hours.

When the opening in the diaphragm cannot be closed by ordinary means, it can be accomplished sometimes by resecting the ribs in front of the hernia. The danger of pneumothorax is generally overestimated; if the chest is opened gradually, the symptoms are slight. A differential pressure cabinet is unnecessary. If dyspnea appears during operation, the lung should be drawn down to the wound and steadied with soft rubber-covered forceps. Before completing the operation, a small blunt trocar attached to a syphon bottle should be inserted into the pleura. At the completion of the suture all the air in the chest can be readily aspirated, and the lung reexpanded.

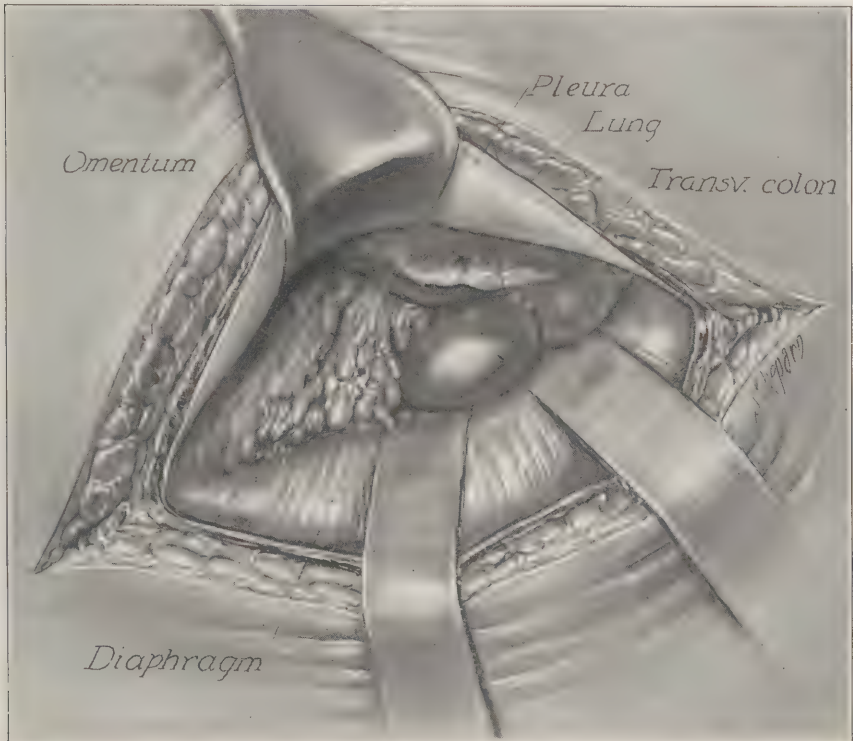


Fig. 172.—The thoracic operation. It is easier to deal with the hernia through a thoracic incision than through an abdominal incision, because the hernia is more accessible through the thorax. The thoracic approach is indicated when there is traumatic injury of the pleura, lungs, heart or blood-vessels, accompanied by hemorrhage.

If the chest has been opened under local anesthesia, the patient can be allowed to come out of the general anesthetic as soon as the diaphragm is closed; with assistance, he can close his mouth, hold his nose, and by blowing, expand the lung as the final suture is tied. If there is danger of infection, or if there has been an extensive separation of adhesions, a drain can be left in the pleura; however, when possible, the wound should be closed without drainage.

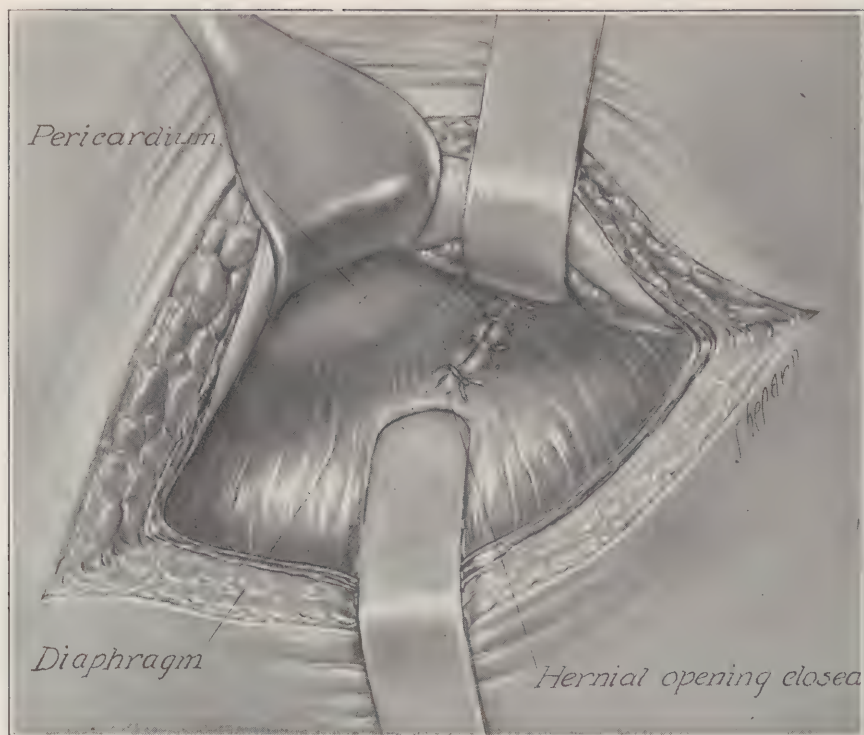


Fig. 173.—The thoracic operation. The opening in the diaphragm is easily closed by interrupted sutures.

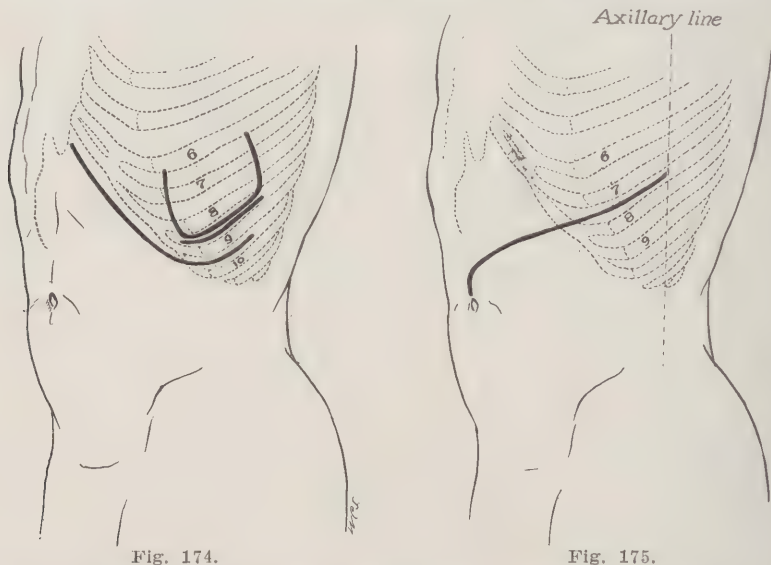


Fig. 174.

Fig. 175.

Fig. 174.—The thoracic operation. The principal incisions are illustrated. (For descriptions see the text.)

Fig. 175.—The combined thoraco-abdominal operation. The incision begins in the axillary line, and extends forward in the seventh intercostal space. The pleura is opened. The incision curves downward over the rectus muscle to the midline, and then down to the umbilicus. The peritoneal cavity is opened and the cartilaginous portions of the ribs cut with scissors. The diaphragm is cut through to the hernial opening.

3. The Combined Operation.—The combined operation is the treatment of choice in a great many cases, and it is being used with increasing frequency. Often it is necessary to open both the thorax and the abdomen, to reduce the hernia and to deal with complications. Some operators prefer to open the thorax and then the abdomen by separate incisions; others use the single incision which exposes both cavities simultaneously.

Schwartz and Quénu recommend the combined thoraco-abdominal route in all cases. The incision begins in the axillary line and extends forward in the 7th intercostal space. The pleural cavity is opened, care being taken to avoid a too sudden pneumothorax or injury to herniated viscera that may be adherent to the chest wall. The incision curves downward over the rectus muscle to the mid-line, and then down to the umbilicus. The peritoneal cavity is opened; the cartilaginous portion of the ribs, at the site of incision, is cut with scissors; and the incision continued in a straight line through the diaphragm to the hernial opening. The adhesions are separated, the viscera reduced, the margins of the opening freshened and sutured, the cartilaginous edges brought together and the wound closed. If necessary, a drain can be left in the lower part of the pleural cavity for two or three days. Auvray resected the 9th rib and continued the incision down to the umbilicus. He cut through the 9th costal cartilage and incised the diaphragm up to the hernial opening. The hernia is reduced, the opening sutured, and the wound closed.

Strangulated Diaphragmatic Hernia.—Strangulated diaphragmatic hernia is not common because small intestine is seldom part of the hernial mass. When it does occur, the treatment is the same as for strangulation elsewhere.

Bibliography

DIAPHRAGMATIC HERNIA

- AUVRAY, M.: Hernie diaphragmatique de l'estomac, du côlon transverse et de l'épiploon, consécutive à une plaie thoraco-abdominale ancienne. Intervention. Guérison. Bull. et mém. Soc. chir. de Par., 1919, xlv, 698-709.
- BALFOUR, D. C.: Nonstrangulated diaphragmatic hernia due to indirect injury. Ann. Surg., Phila., 1916, lxiii, 78-82.
- BAYNE-JONES, S.: Eventration of the diaphragm. Arch. Int. Med., Chi., 1916, xvii, 221-237.
- BEVAN, A. D.: Hernia of the diaphragm. Surg. Clin., Chi., 1917, i, 463-469.
- BLUM, A., AND OMBREDANNE, L.: Hernies diaphragmatiques d'origine traumatique. Arch. gén. de méd., Par., 1896, i, 5-23; 178-196.
- BOCHDALEK, V. A.: Einige bemerkungen über die entstehung des angeborenen zwerchfellbrüches. Vrtljschr. f. d. prakt. Heilk., Prag, 1848, iii, 89-97.
- CARSON, N. B., AND HUELSMANN, L.: Diaphragmatic hernia diagnosed before operation. Interstate M. J., St. Louis, 1912, xix, 315-327.
- CHAMBRELENT, J., AND PRINCETEAU, W. R.: Sur un cas de hernie diaphragmatique congénitale. J. de méd. de Bordeaux, 1897, xxvii, 99-102.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, London, Longman, Reese, Orme, Brown & Green, 1827.
- CRANWELL, D. J.: Diagnostie et traitement de la hernie diaphragmatique. Rev. de chir., Par., 1908, xxxviii, 33-54.
- CRUVEILHIER, J.: Traité de l'anat. path. générale. Paris, Baillière, 1849, i, 617.

- FOSTER, N. B.: Reports of unusual cases, with the anatomical diagnosis. N. York M. J., 1920, cxii, 77-79.
- FUNCK-BRENTANO: Hernie diaphragmatique congénitale chez un nouveau-né ayant vécu 65 heures. Bull. d. Soc. méd. . . . du dép. de la Seine, Par., 1900, iii, 414-417.
- GIFFIN, H. Z.: The diagnosis of diaphragmatic hernia. Ann. Surg., Phila., 1912, lv, 388-397.
- GRASER, E.: Hernia. In: A system of practical surgery. Bergmann, Bruns, Mikulicz. English transl. ed. by W. T. Bull. New York & Phila., Lea Bros. & Co., 1904, iv, 624-629.
- GREIWE, J. E.: A rare case of diaphragmatic hernia. Med. Press & Circ., Lond., 1920, n. s., cx, 520-521.
- HELSTED, A.: Et Tilfaelde af opereret Hernia diaphragmatica. Hosp.-Tid., Kjobenh., 1918, lxi, 881-890.
- HIPPOCRATES: See Morgagni, J. B.: p. 322.
- KEITH, A.: Diaphragmatic herniae. Brit. M. J., Lond., 1910, ii, 1297-1298.
- KEITH, D. Y.: A true congenital hernia in the right diaphragm. Am. J. Roentgenol., N. Y., 1920, vii, 288-291.
- KNAGGS, R. L.: On diaphragmatic hernia of the stomach and on torsion of the small omentum and volvulus of the stomach in association with it. Lancet, Lond., 1904, ii, 358-364.
- LACHER, L.: Ueber Zwerchfellshernien. I. D., Leipz., 1880.
- LECLERC, C.: Contribution à l'étude des hernies diaphragmatiques congénitales. Thèse, Paris, 1901.
- LEICHTENSTERN, O.: Zur diagnose der Hernia diaphragmatica. Berl. klin. Wchnschr., 1874, xi, 539-542; 551-554.
- MACMILLAN, A. S.: Diaphragmatic hernia. Am. J. Roentgenol., N. Y., 1920, vii, 143-146.
- MATHEWS, F. S., AND IMBODEN, H. M.: Hernia of the diaphragm. Ann. Surg., Phila., 1920, lxxii, 668-670.
- MERCADÉ, S.: Hernie diaphragmatique congénitale; perforation par éclat d'obus de l'estomac hernié dans la cavité thoracique gauche. Presse méd., Par., 1917, xxv, 166-168.
- MITCHELL, J. F.: Diaphragmatic hernia. South. M. J., Birmingham, 1917, x, 561-564.
- MORGAGNI, J. B.: De sedibus, et causis morborum. Venetiis. Remondiniana, 1761, ii, 322-326.
- MURRAY, L. M., AND MORGAN, J. D.: Diaphragmatic hernia; with report of a case of the acquired condition. Lancet, Lond., 1917, ii, 857-858.
- PAILLARD, G.: Les variétés anatomiques de la hernie diaphragmatique congénitale. Thèse, Paris, 1903.
- PANNER, H. J.: Roentgenbilledet ved hernia diaphragmatica. Hosp.-Tid., Kjobenh., 1918, lxi, 890-895.
- PARÉ, A.: Oeuvres. Paris, G. Buon, 1579, pp. 379-382.
- PETIT, J. L.: Oeuvres complètes. Limoges, F. Chapouland, 1837, pp. 616-620.
- PLATNER, J. Z.: See Morgagni, J. B.: p. 323.
- POSTEMPSKI, P.: La suture du diaphragme dans les hernies diaphragmatiques par traumatismes. Verhandl. d. X internat. med. Cong., 1890, Berl., 1891, iii, 7. Abth. 188.
- POZZI, S.: Hernie diaphragmatique gauche, congénitale, sans sac, etc. Bull. Soc. anat. de Par., 1872, xlvii, 90-95.
- PRAT, L.: Hernies diaphragmatiques. J. de chir., Par., 1920, xvi, 43-65.
- RAUERT, C.: Ueber Zwerchfallshernien. [Freiburg.], I. D., Hanover, 1900.
- REISCHAUER, T.: Ueber eine den carcinomatösen Magen enthaltende Hernia diaphragmatica vera. I. D., Leipz., 1913.
- RIGGS, T. F.: Diaphragmatic hernia. Ann. Surg., Phila., 1920, lxxi, 276-279.
- RINGROSE, E.: A case of diaphragmatic hernia in an adult. Brit. M. J., Lond., 1910, ii, 1673-1674.
- RYDYGIER, L.: See Graser, E.: p. 628-629.
- SAILER, J., AND RHEIN, R. D.: Eventration of the diaphragm, with a report of a case. Am. J. M. Sc., Phila., 1905, n. s., cxxix, 688-705.
- SCHWARTZ, A., AND QUÉNU, J.: Le traitement des hernies diaphragmatiques (technique opératoire). Paris méd., 1919, xxxiii, 162-165.
- SCUDDER, C. L.: A case of nontraumatic diaphragmatic hernia. Surg., Gynec. & Obst., Chi., 1912, xv, 261-267.
- SLATER, B. H., AND MACKENZIE, C.: A fatal case of acute intestinal obstruction, resulting from traumatic diaphragmatic hernia. Lancet, Lond., 1923, i, 484.
- SORESÌ, A. L.: Diaphragmatic hernia. Ann. Surg., Phila., 1919, lxxix, 255-270.
- SPENCER, W. G.: Diaphragmatic hernia. Medical Science abstracts and reviews. Oxford Univ. Press, Lond. & N. Y., 1921, iii, 319-329.

- STEHELINUS, B.: Tentamen Medicum. 1724. *In*: Haller. Disputationum anatomicarum selectiorum. Gottingæ, A. Vandenhoeck, 1761, vi, 675-686.
- SYMONDS, C. P.: Notes on a case of traumatic hernia of the diaphragm proving fatal seven months after the wound. *J. Roy. Army Med. Corps*, Lond., 1917, xxix, 349-353.
- TAYLOR, H. Y. C., AND LINDSAY, J.: Case of diaphragmatic hernia. *Tr. of Glasgow Obst. & Gynec. Soc.*, 1904, iv, 252-254.
- THOMA, R.: Vier Fälle von Hernia diaphragmatica. *Arch. f. path. Anat. [etc.]*, Berl., 1882, lxxxviii, 515-555.
- TULEY, H. E.: Diaphragmatic hernia. *Miss. Valley M. J.*, Louisville, 1918, xxv, 221.
- VITRAC, J.: Hernie diaphragmatique étranglée. *J. de méd. de Bordeaux*, 1916, lxxxvii, 189-192.
- VOGEL, K. M.: Diaphragmatic hernia, with report of a case. *Am. J. M. Sc.*, Phila., 1913, cxlv, 206-219.
- WALDEYER, W.: Ueber die Beziehungen der Hernia diaphragmatica congenita zur Entwicklungsweise des Zwerchfells. *Deutsche med. Wehnschr.*, Berl., 1884, x, 211-212.

CHAPTER XVIII

INTERNAL HERNIA

Synonyms.—Retroperitoneal hernia; Intraperitoneal hernia.

Definition.—An internal hernia is a protrusion of abdominal viscera into one of the internal abdominal fossae.

Internal hernias are of interest to the general surgeon from the standpoint of diagnosis and treatment. They are very rare and diagnosis is practically impossible except at operation. (For a more extensive study of the anatomy of the peritoneal folds and fossae, consult the excellent monographs of Moynihan and Hertzler.)

Varieties of Internal Hernias

Internal hernias are divided into four general groups:

1. Duodenal.
2. Pericecal.
3. Intersigmoid.
4. Through the foramen of Winslow.

DUODENAL HERNIA. (HERNIA OF TREITZ, COOPER'S HERNIA)

Historical

The duodenal fossa was first described by Hensing, in 1742. Haller, in 1754, spoke of it; Bordenave, in 1779, briefly described a case of duodenal hernia; Sandifort, in 1780, noted the opening; Neubauer, in 1786, reported a case of duodenal hernia; Monro, in 1803, called the opening the duodenal "ring"; Cooper observed a hernia in this fossa and Huschke in 1844, described the fossa as triangular in shape. It remained for Treitz's classical description of the anatomy of this hernia which appeared in 1857, to establish the importance of internal hernias into the peritoneal fossae.

Huschke and Treitz described a single duodenal fossa; a different one was described by Eppinger in 1870; Gruber, in 1869, and Landzert, in 1871, noted two duodenal fossae; Jonnesco described an additional one in 1890, and two more a little later; Broesike, in 1891, published an important summary of the literature up to that time and Moynihan in 1906, described 9 duodenal fossae.

Anatomy

Varieties of Duodenal Hernias.—Duodenal hernias are designated by the name of the fossa in which they occur. Moynihan described nine fossae in which internal hernias may be found. The most important fossae are:

1. The superior duodenal fossa (Eppinger).
2. The inferior duodenal fossa (Treitz).
3. The paraduodenal fossa (Landzert).
4. The mesentericoparietal fossa (Waldeyer).
5. The mesocolic fossa.

The unimportant or rare fossae are:

6. The posterior duodenal fossa (Gruber).
7. The duodenojejunal fossa (Huschke).
8. The recessus intermesocolicus transversus.
9. The infraduodenal fossa.

1. **The Superior Duodenal Fossa.**—The superior duodenal fossa is the upper part of the duodenojejunal fossa originally described by Treitz, and it is present in 40 to 50 per cent of all subjects. It may exist alone, although it is usually associated with an inferior duodenal fossa. The superior duodenal fossa lies to the left of the ascending portion of the duodenum, opposite the level of the second lumbar vertebra. This fossa is bounded above, by the superior duodenal fold, which presents a semilunar margin that merges on the right, into the peritoneum that covers the ascending duodenum, and on the left, with the peritoneum in front of the left kidney. The inferior mesenteric vein nearly always corresponds to the point of junction between the superior duodenal fold and the posterior parietal peritoneum. The fossa is usually about one inch (2.5 cm.) deep; it often admits a third of the finger. Its orifice looks downward, and it terminates in the angle formed by the left renal vein as it crosses the aorta.

2. **The Inferior Duodenal Fossa.**—The inferior duodenal fossa represents the duodenojejunal fossa described by Treitz. It is the most constant of the duodenal fossae, being present in 70 to 75 per cent of all subjects. It is situated on the left side of the ascending duodenum opposite the third lumbar vertebra. The orifice of the fossa is directed upward, and is bounded in front by a sharp margin of peritoneum—the inferior duodenal fold. When a superior duodenal fossa and an inferior duodenal fossa coexist, they share a single orifice which is generally oval in shape. There is often an extension of the fossa behind the ascending duodenum: this gives a large fossa that is particularly liable to become the site of hernia. (Fig. 176.)

3. **Paraduodenal Fossa.**—The paraduodenal fossa was first described by Landzert in 1871. It is most frequently seen in the fetus or the newly born. It is situated on the left side, some distance from the ascending duodenum. It is a pocket formed by the fold of peritoneum, the plica venosa which covers the inferior mesenteric vein, and is most apparent when the colon is pulled strongly upward.

4. **The Mesentericoparietal Fossa.**—The mesentericoparietal fossa was described in 1874 by Waldeyer, who stated that the formation of this fossa is due to the raising up of a peritoneal fold by the superior mesenteric artery.

This fossa is rarely found excepting in the fetus and the newly born. It is usually situated behind the superior mesenteric artery, just below the duodenum. It is possible that this variety of fossa accounts for some of the reported cases of hernia into the mesentery or through rents in the mesentery.

5. The Mesocolic Fossa.—The mesocolic fossa, which was described by Cooper in 1797, is rarely present. It is formed by the peritoneal fold that contains the ascending branch of the left colic artery; this fold is semi-lunar in shape and forms the anterior boundary of the fossa. The fossa lies to the left of the ascending duodenum and the inferior mesenteric vein, between the layers of the transverse mesocolon, and extends to the left toward the splenic flexure of the colon.

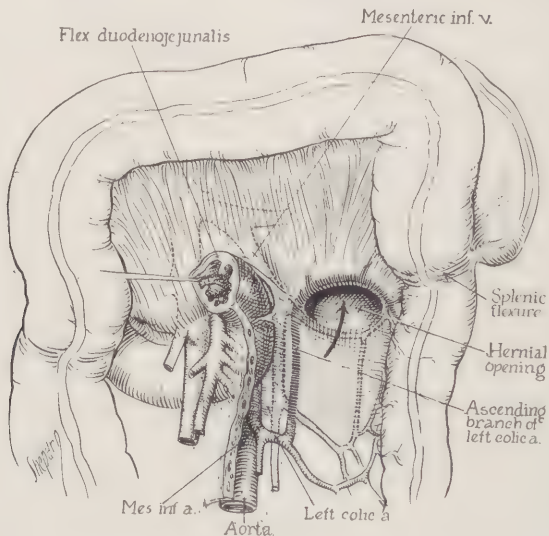


Fig. 176.—The inferior duodenal fossa. This is the most constant of the duodenal fossæ, being present in 70 to 75 per cent of all cases.

6. The Posterior Duodenal Fossa (Recessus Duodenojejunalis Posterior of Broesike, the Duodenojejunal Fossa of Jonnesco).—The posterior duodenal fossa was first described by Gruber in 1862. It lies behind the upper part of the ascending duodenum and is bounded behind by the parietal peritoneum that covers the lumbar vertebrae. The opening of the fossa is directed upward, slightly to the left, and is situated just above the duodenojejunal flexure. It is bounded on its side by two folds of peritoneum, the *plicae duodenales superior* of Broesike.

7. The Duodenojejunal Fossa.—The duodenojejunal fossa was first described by Huschke in 1844. This fossa is present in 15 to 20 per cent of subjects and is rarely, or never, associated with any other variety of duodenal fossa. It is exposed by pulling the transverse colon upward, and by pulling the jejunum downward and to the right. The fossa appears as a circular opening directed downward and to the right, and is bounded by

two folds of peritoneum, the duodenomesocolic ligaments. The fossa is about one inch (2.5 cm.) deep. It is bounded above by the pancreas; on the right by the aorta; on the left by the kidney; and below by the left renal vein.

8. The Intermesocolic Fossa.—The intermesocolic fossa was described by Broesike, who believed it is a modification of the duodenojejunal fossa. The intermesocolic fossa is bounded by the transverse mesocolon and pancreas above, and below, by the ascending duodenum and duodenojejunal flexure. The fossa is covered by a fold of peritoneum that extends between the under surface of the transverse mesocolon and the line of attachment of the mesojejunum.

9. The Infraduodenal Fossa (Retroduodenal Fossa).—The infraduodenal fossa was described by Jonnesco in 1893. It is bounded in front by the posterior aspect of the horizontal and ascending portions of the duodenum; behind by the aorta, which projects into the fossa; and on both sides by folds of peritoneum—the duodenoparietal folds. The fossa is usually from 3 to 4 inches (7.5 to 10 cm.) deep. Its orifice is directed downward, and its apex often reaches to the pancreas and to the duodenojejunal angle.

Clinical Varieties.—From a clinical standpoint, duodenal hernias are named according to the side on which they occur. Left duodenal hernias are the most frequent; of 70 cases collected from the literature by Moynihan, 57 were on the left side. Left duodenal hernias nearly always occur in the paraduodenal fossa, while right duodenal hernias almost always originate in the mesentericoparietal fossa.

The Size of the Hernia.—Duodenal hernias vary greatly in size. They may be no larger than a hen's egg, or as large as an adult's head. The amount of intestine in the hernia may vary from a small knuckle an inch (2.5 cm.) long, as in the case reported by Broesike, to the entire small intestine. Statistics show that, as a rule, the older the subject the larger the sac.

The Hernial Opening.—The opening of the sac is usually behind the hernia, often very close to the lumbar vertebrae. In the small hernias the opening is usually to one side, but as the tumor increases in size, the opening changes to a position posterior to the hernia. The size of the opening varies; it may be so small as to admit only a single finger or it may be large enough for the hand to enter the sac. In the cases collected from the literature by Moynihan, the average size of the opening was $1\frac{3}{8}$ inches (4 cm.) wide, and $2\frac{2}{5}$ inches (6 cm.) long.

The Sac.—The hernial sac is formed by an invagination of parietal peritoneum.

Contents of the Sac.—The small intestine is the usual content of the sac. Sometimes the colon is present, and rarely the cecum or other abdominal viscera.

Etiology

Treitz stated that the following conditions are essential for the formation of duodenal hernia:

1. The existence of a fossa and its peritoneal boundary fold.
2. The presence of the inferior mesenteric vein in the fold.
3. The freedom of movement of the small intestine to permit its entrance into the hernial sac.

Age.—Broesike reported a case of duodenal hernia in an infant, fourteen days old. Treitz saw it in a baby two months old, and Paton saw it in one three months old.

Symptoms

The symptoms of nonstrangulated duodenal hernia are very indefinite and are usually limited to slight digestive disturbances. When there is partial obstruction the symptoms are more pronounced and resemble those of partial enterocele. In case of strangulation, the symptoms are severe and are the same as for other forms of acute intestinal obstruction. When considerable intestine is in the sac, abdominal distention is marked.

The tumor may be confined to a definite part of the abdomen. It is resonant on percussion, and sometimes the loops of intestine can be seen in the mass. In left duodenal hernia, the inferior mesenteric vein is subjected to pressure from the hernia, and this often results in congestion and dilatation of the hemorrhoidal veins, sometimes with hemorrhage.

Treatment

Duodenal hernia is practically never diagnosed except at operation that is undertaken for symptoms thought to be those of ordinary intestinal obstruction, and the hernia is discovered while searching for the obstruction. As a rule, the intestine can be withdrawn from the sac without dividing the neck of the sac. If the neck of the sac cannot be stretched sufficiently to permit the reduction of the intestine, it is necessary to open the sac to the outer side of the inferior mesenteric vein, withdraw the intestine, incise it, empty its contents, suture the wound in the intestine, and withdraw the collapsed loops through the constricting ring. The inferior mesenteric vein must never be divided under any circumstances. After reduction of the hernia, the opening in the sac should always be closed by sutures on account of the danger of recurrence.

CECAL HERNIA

Cecal Fossae.—There are four principal fossae in the cecal region, namely, the ileocolic, ileocecal, retrocecal and retroappendicular.

1. *The Ileocolic Fossa (Anterior Ileocolic Fossa—Jonnescio; Superior Cecal Fossa—Waldeyer; Recessus Ileocecalis—Broesike; Ileocolic Fossa—Lockwood and Rolleston).*—The ileocolic fossa was first described by Luschka in 1861.

It is formed by the ileocolic fold of peritoneum arching over a branch of the ileocolic artery. The fossa is a narrow opening situated between the ileocolic fold in front, and the mesentery of the ileum behind. This fossa is developed best in children. It is reduced in size and often absent in the aged and in the obese.

2. *The Ileocecal Fossa (Ileoappendicular Fossa—Jonnesco; Inferior Ileocecal Fossa—Waldeyer; Ileocecal Fossa—Huschke).*—The ileocecal fossa was first described by Huschke. It is bounded above by the posterior surface of the



FIG. 177.—The cecal fossae.

ileum and its adjacent mesentery; below by the ileocecal fold; and behind by the upper part of the mesoappendix. This fossa is often well marked in the young, but is usually obliterated by deposits of fat in subjects of advanced years.

3. *Retrocecal Fossa (Fossa Cecalis—Huschke, Waldeyer; Subcecal Fossa—Lockwood and Rolleston; Retrocolic Fossa—Treves, Berry; Retrocecal Fossa—Jonnesco).*—The retrocecal fossa lies behind the cecum and is exposed best by lifting the cecum upward. The retrocecal fossa is bounded in front by the cecum; behind by the parietal peritoneum; and on each side by the parieto-

colic folds. This fossa is sometimes deep enough to admit an entire finger. (Fig. 177.)

4. *The Retroappendicular Fossa (The Recessus Retroappendicularis—Leichtenstern).*—The retroappendicular fossa was first described by Hartmann in 1870. It is a small depression between the mesentery of the appendix and the plica infraangularis of Broesike—a peritoneal fold which sometimes extends from the ileocolic angle and the posterior and inner aspect of the cecum backward to the iliac fossa. The retroappendicular fossa is inconstant and of little surgical importance, though Snow reported a case of hernia in this fossa.

Symptoms

In the cases of cecal hernia collected from the literature by Moynihan, only 2 patients gave previous histories of abdominal symptoms. Atherton's patient was operated on for what was thought to be chronic appendicitis. Moullin's patient gave a history of four previous attacks of acute intestinal obstruction, similar to the last one that proved fatal.

The symptoms of strangulated cecal hernia are those of acute intestinal obstruction—sudden abdominal pain, nausea, vomiting, absolute constipation, distention of the abdomen, shock and collapse.

Treatment

Cecal hernia is rarely or never diagnosed until operation is undertaken, usually for intestinal obstruction. The strangulation is easily located, and in the cases reported in the literature, there has been no difficulty encountered in reducing the strangulated loop. In ileocecal hernia excision of the appendix will obliterate the fossa; in the other varieties the sac should be closed by suture to prevent recurrence.

INTERSIGMOID HERNIA

The Intersigmoid Fossa.—The intersigmoid fossa was first mentioned by Hiensing in 1742, and described by Haen in 1769. Roser, in 1843, encountered this fossa and recognized it. Engel, in 1857, studied it and asserted that it was obliterated in adults. Treitz thoroughly described it in 1857, and in 1868 Waldeyer described a double fossa.

The intersigmoid fossa lies between the sigmoid mesocolon and the parietal peritoneum. It is exposed best by drawing the sigmoid upward, toward the left; the opening will be seen at the point of insertion of the sigmoid mesocolon. The intersigmoid fossa is present in a majority of subjects. Treves found it in 52 per cent of cases; Eccles in 53 per cent; Gruber in

60 per cent; Moynihan and Jonnesco in 70 per cent, and Waldeyer in 84 per cent. (The difference in percentage is largely due to the varying ages of the subjects.) In the fetus and newly born the fossa is nearly always present. It becomes less constant as age advances until after the 50th year, when it is usually absent.

The opening of this fossa is round or oval and is bounded in front by a fold of peritoneum that contains the sigmoid vessels. The fossa lies behind the mesosigmoid, and in front of the parietal peritoneum, just above the inner margin of the psoas magnus muscle. The parietal peritoneum that forms the posterior wall of the fossa is adherent to the common iliac artery, and overlies the ureter at the point where the ureter crosses the artery. The size of the fossa varies. It is often only a dimple, or it may be 2 to 3 inches

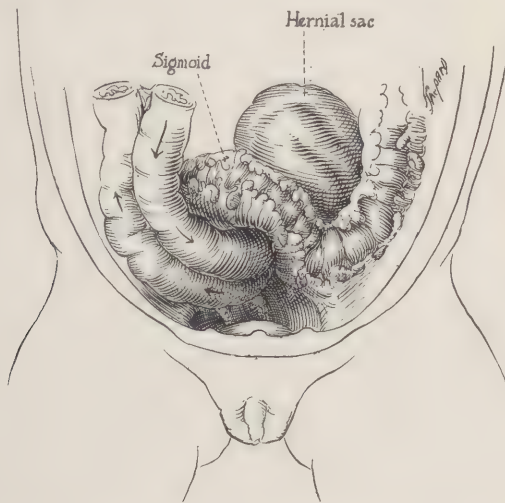


Fig. 178.—Hernia through the intersigmoid fossa.

(5 to 7.5 cm.) or more deep. Sometimes it extends as high up as the body of the pancreas. The fossa is usually the size and shape of a finger cot for an average middle finger. Intersigmoid hernia is very rare; only a few cases have been recorded. (Fig. 178.) Diagnosis has never been made before operation, and the treatment is the same as for cecal hernia.

HERNIA INTO THE FORAMEN OF WINSLOW

The foramen of Winslow is the opening between the greater and lesser peritoneal sacs. It is bounded above by the caudate lobe of the liver; below by the duodenum and hepatic vessels; in front by the lesser omentum that contains the hepatic artery, portal vein and bile duct; and behind by the vena cava. The opening is directed forward and to the right. It is easily

seen when the liver is lifted upward. It is usually about the size of a finger, but in adults and the aged it is often narrowed by inflammatory adhesions.

Etiology

Hernia into the foramen of Winslow is very rare. The most probable predisposing causes are a large foramen of Winslow, an abnormally long mesentery, and excessive mobility of the intestine. (Fig. 179.)

Symptoms

In the majority of the reported cases, the symptoms of acute intestinal obstruction appeared suddenly. The pain was localized in the epigastric region, being more severe than in ordinary cases of obstruction. There is often a tumor in the epigastric region that is resonant on percussion.

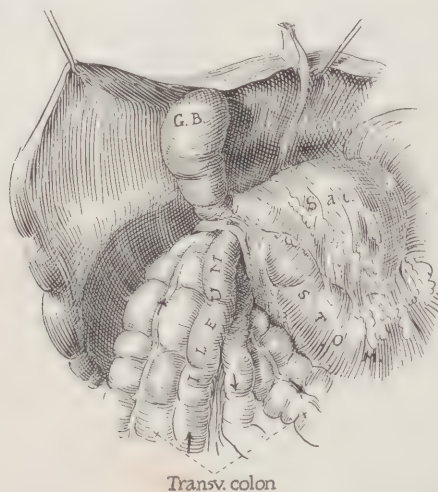


Fig. 179.—Hernia through the foramen of Winslow.

Treatment

Hernia through the foramen of Winslow is rarely or never suspected until operation is undertaken for the symptoms of acute intestinal obstruction. When the abdomen is opened, the condition is usually apparent. As a rule, the intestine can be withdrawn through the foramen. However, when this is impossible, the lesser peritoneal sac should be opened by incising the gastrohepatic or the gastrocolic omentum; the strangulated intestine is withdrawn, incised, emptied of its contents, the wound in the intestine closed, and the collapsed loops of intestine returned to the general peritoneal cavity through the foramen of Winslow. The foregoing procedure is necessary, because the foramen of Winslow cannot be enlarged without dividing the hepatic artery, portal vein and common bile duct.

HERNIA THROUGH THE TRANSVERSE MESOCOLON

Hernia through the transverse mesocolon is very rare, and only a few cases have been recorded. The condition is easily recognized at operation and presents no difficulties in treatment. When a hernia is found in the lesser peritoneal sac and the foramen of Winslow is patent, the point of constriction should be looked for in the transverse mesocolon.

In 1,600 autopsies reported by Mitchell, holes were found in the mesentery in 3 subjects. In each case the opening was situated near the junction of the large and small intestines. In one subject, a woman, aged 45, the opening measured $1 \times 1\frac{7}{8}$ inches (2.5×4.75 cm.). There was no hernia found in any of the subjects.

Bibliography

INTERNAL HERNIA

- ATHERTON, A. B.: Retroperitoneal hernia. *Ann. Surg., Phila.*, 1903, xxxvii, 883-885.
- BERRY, R. J. A.: The cæcal folds and fossæ. *Edinb., W. F. Clay*, 1897.
- BORDENAVE, T.: See Moynihan, B. G. A.: p. 48.
- BROESKE, G.: Ueber intra-abdominale (retroperitoneale) Hernien und Bauchfelltaschen, nebst einer Darstellung der Entwicklung peritonealer Formationen. *Berlin, Fischer*, 1891.
- COOPER, A. P.: On hernia. *London, Longman & Co.*, 1804-7.
- ECCLES, W. M.: Hernia. 3rd ed., *New York, Wood & Co.*, 1908.
- ENGEL: Einige Bemerkungen über Lageverhältnisse der Baueingeweide in gesunden Zustände. *Wien. med. Wchnschr.*, 1857, vii, 553-557; 585-588; 601-605; 641-644; 673-676; 705-708; 737-741.
- EPPINGER, H.: Hernia Retroperitonealis. *Vrtljschr. f. d. prakt. Heilk., Prag*, 1870, cviii, 121-151.
- GRUBER, W.: Ein von einer grossen Ileum-Portion und einer kleinen secundären Schlinge der Flexura sigmoides geknüpfter Knoten (Schleif), dazu eine Zusammenstellung der Fälle derselben Gattung und der daraus resultirenden Classification. *Arch. f. path. Anat. [etc.]*, *Berl.*, 1869, xlviii, 468-487.
- HAEN, T.: Ratio medendi in nosocomio practico. *Parisiis, P. F. Didot*, 1769, vi, 103.
- HALLER, A.: *Primæ lineæ physiologiæ*. *Venetii, L. Basilium*, 1754, p. 259-266; 286-287.
- HARTMANN, H. J.: Die Bauchfelltaschen in der Umgebung des Blinddarms. *I. D., Tübing.*, 1870.
- HENSING, F. W.: De peritonæo. *Giessæ*, 1742. *In: Haller. Disputationum anatomicarum selectarum. Gottingæ, A. Vandenhoeck*, 1750, i, 349-385.
- HERTZLER, A. E.: The peritoneum. *St. Louis, C. V. Mosby Co.*, 1919, i, 189-237.
- HUSCHKE, E.: Lehre von den Eingeweiden und Sennesorganen des menschlichen Körpers. *In: Semmerring's vom Baue des Menschlichen Körpers. Leipz., L. Voss.*, 1844, v, 5.
- JONNESCO, T.: Hernies internes rétro-péritonéales. *Paris, Steinheil*, 1890.
- LANDZERT, W.: Ueber die Hernia retroperitonealis (Treitz) und ihre Beziehungen zur Fossa duodenojejunalis. *St. Petersburg. med. Ztschr.*, 1871, n. f., ii, 350-383.
- LEICHTENSTERN, O.: Constrictions, occlusions, and displacements of the intestines. *In: Ziemssen, H., Cyclopedia of practical medicine. Transl. by R. H. Fitz, New York, W. Wood & Co.*, 1874-80, vii, 550.
- LOCKWOOD, C. B., AND ROLLESTON, H. D.: On the fossæ round the cæcum, and the position of the vermiform appendix, with special reference to retroperitoneal hernia. *J. Anat. & Physiol., Lond.*, 1892, xxvi, 130-148.
- LUSCHKA, H.: Die Anatomie des Menschen. *Tübing, H. Laupp*, 1863, ii, 139.
- MITCHELL, L. J.: Strangulated internal hernia through a mesenteric hole. *Ann. Surg., Phila.*, 1899, xxx, 505-506.
- MONRO, A.: Observations on crural hernia. *Edinburgh, W. Laing*, 1803, p. 8-13.
- MOULLIN, C. W. M.: A case of strangulated hernia into the postcecal pouch. *Lancet, Lond.*, 1899, i, 881-882.

- MOYNIHAN, B. G. A.: On retroperitoneal hernia. New York, W. Wood & Co., 1906.
- NEUBAUER, J. E.: Opera anatomica collecta; curavit G. C. Hinderer. Francofurti et Lipsiæ, J. C. Krieger, 1786, p. 331-342.
- PATON, E. P.: Right duodenal hernia in an infant. *Lancet*, Lond., 1906, i, 971.
- ROSER, W.: Untersuchungen über die Formation der Brüche. *Arch. f. physiol. Heilk.*, Stuttg., 1843, ii, 432-449.
- SANDIFORT, E.: Observationes anatomico-pathologicae. Lugduni, Eyk & Vygh, 1777, i, 65-77.
- SNOW, J.: Case of strangulation of the ileum in an aperture of the mesentery. *Med. Gaz.*, Lond., 1846, n. s., iii, 1049-1052.
- TREITZ, W.: Hernia retroperitonealis. Prag, F. A. Credner, 1857.
- TREVES, F.: The anatomy of the intestinal canal and peritoneum in man. London, Lewis, 1885; Hunterian Lecture (also in *Brit. M. J.*, 1885, i, 415-419; 470-474; 527-530; 580-583).
- WALDEYER, W.: Hernia retroperitonealis nebst Bemerkungen zur Anatomie des Peritoneums. *Arch. f. path. Anat.* [etc.], Berl., 1874, lx, 66-92.

CHAPTER XIX

LUMBAR HERNIA

Synonyms.—Hernia dorsalis; Petit's hernia; Grynfeldt's hernia.

A lumbar hernia may appear anywhere in the lumbar region, which is bounded above by the twelfth rib; below by the crest of the ilium; in front, by a line drawn vertically downward from the anterior extremity of the twelfth rib to the crest of the ilium; and behind by the vertebral column and the erector spinae muscles.

Lumbar hernia may be congenital or acquired, and the acquired form may be spontaneous or traumatic.

Historical

The possibility of hernia occurring in the lumbar region was first suggested by Barbette in 1672. Blancard in 1701, and Dolée in 1703, knew of lumbar hernia, but their writings, as well as those of Reneaulme de Lagaranne in 1726, contain no record of a case. In 1728 Budgen described a case of congenital lumbar hernia, but it is evident he did not know what it was. The first authentic case was observed and recorded in 1731 by De Garengoeut, who reduced the hernia after death. In 1738 a case of strangulated hernia, through the triangle that bears his name, was described by Petit. In 1750 Ravaton published the first report of a patient with strangulated lumbar hernia who survived operation. Until 1866 when Grynfeldt described the superior lumbar triangle, lumbar and ventral hernia were frequently confused, and all lumbar hernias were supposed to come through Petit's triangle—the inferior lumbar triangle. In 1767 Heuermann described a case of strangulated hernia which was cured spontaneously by the formation of an artificial anus. Balin, in 1768, described a lumbar hernia making its exit above the ilium and behind the external oblique. Valuable papers on lumbar hernia have been published by Braun, Jeannel, Goodman and Speese, and Campora.

Statistics

In 1923 I collected from the literature 115 cases of lumbar hernia.

Sex.—The sex was given in 96. Of these 70 were males and 26 females.

Age.—The age was given in 97 as follows:

Under 2 years	7
2 to 10 years	16
11 to 20 years	8
21 to 30 years	7
31 to 40 years	8
41 to 50 years	7
51 to 60 years	14
61 to 70 years	15
71 to 80 years	2
Adult	8
Old	5
	<hr/> 97

Side Involved and Point of Exit.—The side involved or the point of exit of the hernia, or both, were given in 88 cases as follows:

PETIT'S TRIANGLE				GRYNFELTT-LESSHAFT TRIANGLE				TRIANGLE NOT STATED		
R.	L.	BILAT- ERAL	SIDE NOT GIVEN	R.	L.	BILAT- ERAL	SIDE NOT GIVEN	R.	L.	BILAT- ERAL
6	15	1	8	7	11	1	11	3	24	1

Varieties of Lumbar Hernia.—Lumbar hernia is usually classified according to its etiology into three varieties, congenital, spontaneous acquired, and acquired traumatic. In the 115 cases I collected the causes were as follows:

Congenital		18
Spontaneous acquired	{ fall	9
	{ strain	9
	{ lifting	3
	{ injury	3
	{ "spontaneous"	40
Acquired traumatic	{ abscess of lung	1
	{ abscess of spine or scoliosis	16
	{ postoperative	3
Cause unknown		12
		<hr/> 115

Strangulation.—Strangulation was present in 13 (11.3 per cent).

Treatment.—The treatment employed and the result were given in 70 cases as follows:

	Recovered	Died
Hernia reduced	24	0
Hernia treated by operation	42	1
Hernia incised in mistake for abscess	1	0
Strangulation with spontaneous rupture	1	0
Strangulation untreated	0	1

Anatomy

1. **Course of Lumbar Hernia.**—The lumbar region presents several weak points through which the abdominal contents can escape. The two usual openings are the inferior lumbar, or the triangle of Petit; and the superior lumbar triangle, or Grynfeltt-Lesshaft space. The abnormal openings in the muscles and aponeurosis may appear anywhere in the lumbar region, and are either congenital or acquired. (Fig. 180.)



Fig. 180.—The anatomy of lumbar hernia. On the left, Petit's triangle. On the right, the superior lumbar triangle of Grynfeltt-Lesshaft.

Various investigators have described different places as the weakest, and hence the most likely point of outlet for a lumbar hernia. Braun described a defect in the latissimus dorsi. Lieber and others have reported inconstant defects in the wall of the lumbar region near the inferior lumbar triangle, which could be the sites of lumbar hernia.

There is considerable controversy as to whether lumbar hernia makes its exit through the inferior lumbar triangle, or the superior lumbar triangle. The general opinion among recent investigators is that most of these hernias appear primarily in the superior lumbar triangle.

a. *Inferior Lumbar Triangle* or triangle of Petit. The inferior lumbar triangle is bounded in front by the external oblique; behind, by the anterior border of the latissimus dorsi; and below by the crest of the ilium. The floor is covered by the heavy lumbar fascia; beneath this are the muscular fibers of the internal oblique, and deeper still, the aponeurosis of the transversalis abdominis. In some cases the internal oblique at this point is wholly tendinous.

The dimensions of Petit's triangle are variable. It may be merely a slit between the muscles, with a base measuring 5 to 8 mm. (Rochard), or 1 cm. (Charpy) or larger, with a base measuring 4 cm. (Luschka) to 5 to 6 cm. The height of the triangle is usually 1 to 7 cm.

The existence of Petit's triangle is not constant, but is found more frequently in adults than in children. It is not present in very muscular subjects because the latissimus dorsi is overlapped by the external oblique muscle. Lesshaft examined 108 adult and 35 infant cadavers, and found it in 77 per cent of the adults, and in 25 per cent of the infants; Charpy found it in 77 of 100 cases examined. Goodman and Speese in 76 examinations found it in 63½ per cent of the cases.

b. *Superior Lumbar Triangle*.—(Grynfeltt-Lesshaft space; lumbo-costo-abdominal triangle of Grynfeltt; or spatium tendineum lumbale of Baracz; or the rhombus of Lesshaft.) (Grynfeltt in 1866, and Lesshaft in 1870, demonstrated a second opening through which a hernia could occur. The base of this triangle is above, and is bounded by the twelfth rib and the lower border of the serratus posticus inferior; in front, by the posterior border of the internal oblique; and behind, by the anterior border of the erector spinae. This triangle is in front of Petit's triangle, and above it. It is covered by the latissimus dorsi muscle, and the floor is formed by the aponeurosis of the transversalis.

The superior lumbar triangle sometimes takes the form of a quadrilateral, or it may be deltoid, trapezoid, or polyhedral. The size and shape of the space depend upon the development of the serratus posticus inferior; the attachment of the external oblique to the last rib; the length of the twelfth rib; the space between the internal oblique and the lateral border of the erector spinae; the attachment of the latissimus dorsi to the eleventh or twelfth ribs, or its union with the posterior fibers of the external oblique; the development of the quadratus lumborum and internal oblique muscles. The weakest spot is in the upper part of the space a little below the twelfth rib, where the aponeurosis of the transversalis is not covered by the external oblique muscle. The twelfth intercostal nerve accompanied by its artery and vein, penetrate at this point.

The superior lumbar triangle is more constant, and is larger than Petit's triangle; it is found more frequently in adults than in infants and children. Barbé found it in 50 per cent of 100 examinations. Baracz and Burzynski

found it in 71 out of 76 cadavers examined, or 93 per cent. Goodman and Speese, in 76 examinations found it in 93½ per cent of the cases.

c. Irregular Openings in the Muscles and Aponeurosis.—In addition to the superior and inferior lumbar triangles, there are other points in this region through which a hernia may emerge. Slits or buttonhole openings in the aponeurosis, the result of trauma or maldevelopment, may give passage to small fatty hernias (Morestin). Braun believed that lumbar hernia could escape through the apertures for the cutaneous branches of the second and third pairs of posterior lumbar nerves. (Cooper advanced the same opinion as a cause of ventral hernia.) This theory was denied by Macready, who pointed out that the nerves run between the muscles and do not penetrate the whole thickness of the parietes at any one point.

2. Frequency of the Varieties of Lumbar Hernia.—I collected 115 cases of lumbar hernia. In 30 of these, the hernia emerged through the inferior lumbar triangle; and in 30 it appeared through the superior lumbar triangle.

I found 18 cases of congenital lumbar hernia, 65 of spontaneous acquired hernia, and 20 of acquired traumatic hernia, following injury or disease. (No effort was made to collect the last named variety; many more cases are reported in the literature.)

The most frequent locations of the lumbar hernias I collected were the two principal triangles, but in some instances the hernia forced its way through at some other point, namely, through a congenital opening in the abdominal wall; through an opening in the latissimus dorsi; through the external oblique, internal oblique and transversalis; through an opening following necrosis of the iliac crest; and through the cicatrix of a wound.

3. The Sac.—Large hernias are usually subcutaneous, while small ones are sometimes separated from the skin by a layer of fat or muscle, the most frequent covering being either the external or internal oblique muscle. There is usually a sac. There are also instances in which no sac exists, as in the cases observed by Hutchinson, Lejars, Demoulin, and Turner. This hernia which is really a subperitoneal lipoma, is surrounded by a peritoneal cul-de-sac, a condition that is similar, from a pathologic point of view, to a condition we find in extraperitoneal, femoral and bladder hernias. The only lumbar hernia of abdominal viscera that is nearly always without a sac, is hernia of the kidney; this is due to the situation of the kidney underneath the peritoneum.

4. Contents of the Sac.—The sac most frequently contains omentum, sometimes fat, mesentery, large or small intestine, appendix, stomach, cecum, sigmoid, and in rare instances, the kidney. Plenck, in 1774, reported a congenital hernia of the kidney. In 1811 Monro saw a case of bilateral congenital lumbar hernia with the kidneys entirely within the sac, in an infant 6 months old. Bayer observed a case in which the contents of the sac consisted of the small intestine, the ascending colon and the right kidney.

Because of anatomical conditions, the intestine does not appear in the sac of lumbar hernia as frequently as it does in other abdominal hernias. For this reason, lumbar hernias are frequently epiploceles or fatty hernias. Fatty hernias without sacs were described by Marmisse in 1862.

Etiology

The two varieties of lumbar hernia to be considered are congenital and acquired:

1. **Congenital Lumbar Hernia.**—A congenital hernia is one that is present at birth, and is due to malformation, or to arrested or deficient development of muscles, aponeurosis, vertebrae, ilium, or the lower ribs. Any defect that weakens the resistance of the lateral abdominal wall may be the causative factor. This type of hernia is often bilateral and may be associated with other developmental anomalies. Ruiz, in 1915, reported a congenital hernia in an infant who also had a large hydrocele.

There are only a few cases of congenital lumbar hernia on record. Borchardt reported a case in an infant of fifteen months, in which the hernia filled the entire space between the twelfth rib and crest of the ilium. Wyss saw a case in which the posterior serration of the external oblique and the posterior half of the transversalis were deficient. The hernia was very large and came through the superior lumbar triangle. Dowd saw a case in a child aged three and one-half years, where the hernia was the size of a goose-egg. Two years later, in spite of an elastic belt having been worn, the hernia had grown to the size of a man's fist. Grange, in 1896, found 5 congenital hernias in 45 cases collected from the literature. Jeannel in 1902, was able to find 10 additional cases; and in 1923 I collected 8 more.

2. **Acquired Lumbar Hernia.**—Acquired lumbar hernia usually occurs in adults; it may be on either side, is very rarely bilateral, and is much more frequent than the congenital variety. Hernias due to effort, strain, or to trophic changes in the muscles, such as atrophy following acute anterior poliomyelitis, appear in the superior or inferior lumbar triangles; while traumatic hernias due to direct injury and disease may appear anywhere. Acquired lumbar hernia may be either spontaneous or traumatic.

a. **SPONTANEOUS LUMBAR HERNIA.**—Spontaneous lumbar hernia may appear any time after birth, but is most frequently seen in middle and old age. It is generally believed that this variety of lumbar hernia is due to a congenital predisposition, supplemented by indirect injury, strains, such as lifting and coughing. Other causes that may predispose to the development of a spontaneous hernia are obesity, emaciation, old age, chronic bronchitis, emphysema, and laborious occupations. In rare instances no causative factor can be found. In Hurley's case a spontaneous lumbar hernia developed in a boy, aged 4 years, following an attack of whooping cough.

In 65 cases of spontaneous acquired lumbar hernia that I collected from the literature, 42 were in males and 18 in females. In 5 the cases were not given.

Age.—The age was given in 54 patients as follows:

Under 2 years	1
2 to 10 years	2
11 to 20 years	2
21 to 30 years	4
31 to 40 years	3
41 to 50 years	7
51 to 60 years	9
61 to 70 years	13
71 to 80 years	1
Adult	7
Old	5
	<hr/> 54

Side Involved and Point of Exit.—In 42 patients with spontaneous acquired lumbar hernia it appeared in Petit's triangle or the Grynfeltt-Lesshaft triangle as follows:

PETIT'S TRIANGLE				GRYNFELTT-LESSHAFT TRIANGLE			
R.	L.	BILATERAL	SIDE NOT GIVEN	R.	L.	BILATERAL	SIDE NOT GIVEN
5	10	1	3	6	10	1	6

b. **TRAUMATIC HERNIA.**—Traumatic hernia is sometimes called accidental, incisional, postoperative or cicatricial. True traumatic hernia is caused by direct injury, such as a severe crushing blow, or a fall from a height. Hancock reported a case of traumatic hernia through Petit's triangle in a man, which was caused by his being thrown from the top of a railroad car that had been derailed. Rishmiller reported a case of traumatic hernia in Petit's triangle in a man, who was crushed over both thighs by a car wheel, and a piece of bone was broken off the crest of the left ilium.

Operative.—Postoperative hernia may occur when the wound closure has been faulty or when primary healing is delayed, as sometimes occurs after operations for the suppurative diseases of the kidney.

Abscess.—Pott's disease or caries of the vertebrae is the most frequent cause of acquired lumbar hernia. The hernia may also follow a deep abscess, due to osteitis of the ribs or pelvic bones, which has come to the surface through a weak point in the lumbar region. The lumbar abscess may also originate in the liver, intestines or other viscera, or follow the breaking down of an old hematoma. Jaboulay and Patel reported a case of lumbar hernia following the drainage of a liver abscess through the lumbar region.

Symptoms and Diagnosis

Reducible Hernia.—As a rule, reducible lumbar hernia is simple to diagnose. It may vary in size from a small tumor an inch (2.5 cm.) or less in diameter

to one that measures a foot (30 cm.) across. When the tumor is small it is easy to locate, and if it is excessively large it may pass out beyond the confines of the lumbar ring and lie over on the side of the abdominal wall. It



Fig. 181.—Lumbar hernia through Petit's triangle.

is usually hemispherical in shape, but is sometimes ovoid. The size and shape are variable, depending on the posture of the patient, and whether he is in a state of repose or exertion. The impulse from coughing is plainly felt and

a resonant or tympanitic note is heard on percussion. The tumor is soft and reduces easily, usually with a gurgling sound. (Fig. 181.) Congenital hernias are noticed at birth or soon after, and are soft, increasing in size when the child cries.

There are no very marked subjective or functional symptoms. In some cases there is a feeling of fatigue on exertion, pain in the back, colic with vomiting, tenderness on pressure may be felt and a dragging sensation of weight, which disappears when the hernia is reduced. Turner has observed that a dragging sensation in the corresponding lumbar region may be complained of. A lumbar hernia develops very slowly, sometimes being of considerable size before the patient is aware of it.

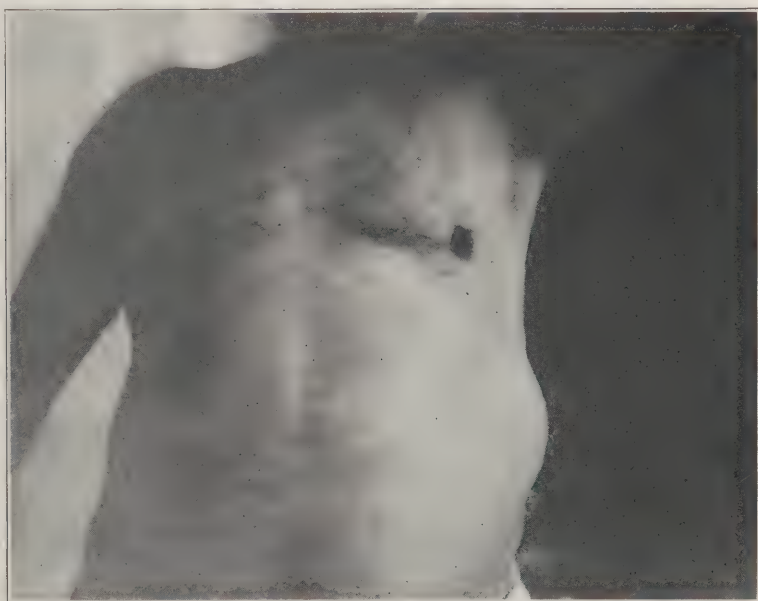


Fig. 182.—Spontaneous left lumbar hernia in a man aged 52. The swelling first appeared after a strain, two years before examination. The tumor has gradually increased in size and there is a slight impulse on coughing. The mass consists mostly of fat and probably comes through the superior lumbar triangle. A bandage was applied, operative treatment being refused.

The diagnosis of fatty hernia is often difficult. When reducible it may appear to be an enterocele, and when adherent and irreducible, it may sometimes be mistaken for an obstructed or strangulated hernia. The lumbar hernias that are most difficult to diagnose are those that are irreducible or strangulated. (Fig. 182.)

Strangulated Hernia.—Because of the large size of the ring and neck of the sac, strangulation by constriction in lumbar hernia is almost impossible, though it does occur occasionally. I collected from the literature 115 cases of lumbar hernia, due to all causes, and found strangulation in 13 (11.3 per cent). In these 13 cases, reduction was effected by taxis in

5, and operation was performed in 3 (Ravaton, Hume, and Lejars). Ravaton's patient recovered after incision, in spite of the usual postoperative evisceration and serious septic peritonitis of preantiseptic days. Hume's patient showed a gangrenous small intestine caused by the pressure of two fibrous bands and a twisted sigmoid. Intestinal resection was done, but the patient died with peritonitis in 24 hours. Lejars' patient had strangulation of the ascending colon, and recovered after operation. One patient in this group of 13 died without any curative measures being attempted, and there are no details given regarding 4 cases.

Spontaneous hernia is more frequently strangulated than other varieties. Of 65 cases I collected, 18 per cent were strangulated. The most frequent cause of strangulation is a constriction at the neck of the sac, or a volvulus.

Differential Diagnosis.—Lumbar hernia must be diagnosed from the following conditions:

Abscess.—The pointing of an abscess in the lumbar region is favored by the natural weakness of the lumbar triangles which are the thinnest points in the lateral and posterior regions of the abdominal wall. As a rule, an abscess gives a history of Pott's disease or other bone involvement; it is soft and fluctuating and is not completely reducible. When it is emptied by pressure, another bulge usually appears nearby, which is the pocket where the pus has been forced.

When the abscess is intramuscular and very voluminous, the fluctuation is difficult to detect. Several cases have been reported where a lumbar hernia has been mistaken for an abscess and incised, resulting in a fecal fistula, which usually closed in time, if no complications developed.

Lipoma.—As a rule the diagnosis of lipoma is simple, with little chance of making a mistake. This tumor is of very slow growth, and can usually be lifted free from the surrounding muscles. There are no subjective symptoms.

Fibroma.—A fibroma usually involves the muscle tissue, and while it is not as freely movable as a lipoma, the typical symptoms of hernia are lacking. It is ordinarily impossible to differentiate fibroma from lipoma until operation.

Muscle Hernia.—A muscle hernia does not reduce, so to speak. It disappears, leaving no hernial orifice that can be felt by the finger.

Hematoma.—Hematoma usually gives a history of trauma, or it may be postoperative.

In all of these conditions the subjective symptoms of intestinal obstruction or strangulation are absent, and the most striking sign of nonstrangulated hernia is lacking, viz.: A reducible swelling that gives an impulse on coughing, leaving a definable ring on reduction.

Prognosis

The prognosis for lumbar hernia is usually favorable. Strangulation is not as frequent as in other varieties. In over half of the strangulated cases reported, reduction has been accomplished by taxis, which was possible because of the large opening and the frequent absence of a sac.

The radical operation is the treatment of choice for children. The results of bandage or truss treatment are unsatisfactory because the hernia tends to increase in size as the child grows and it is difficult to keep the truss in place. In patients past middle life, a small lumbar hernia causes little inconvenience and a truss is often fairly comfortable, as the active movements of the elderly are naturally restricted and accomplished with little muscular effort.

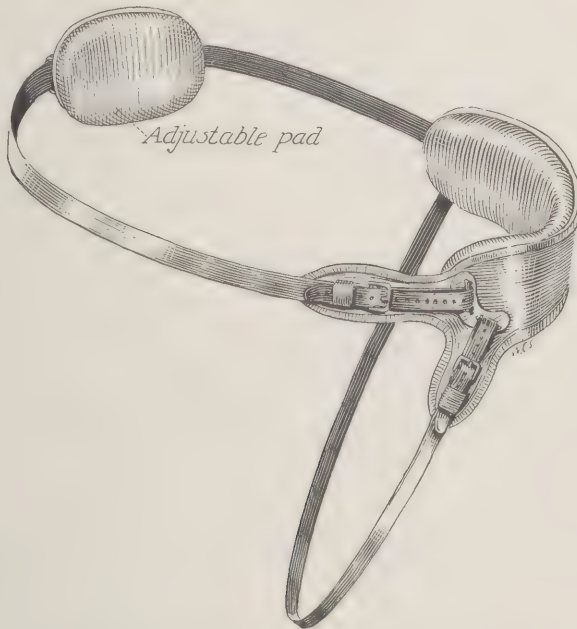


Fig. 183.—Macready's truss for lumbar hernia.

Treatment

1. **Mechanical.**—Lumbar hernia is nearly always reducible and can sometimes be controlled by a truss or bandage. The truss devised by Macready is probably the best. (Fig. 183.) Mechanical treatment is usually unsatisfactory as the hernia increases in size in spite of it, especially in children.

2. **Radical Treatment.**—When there is a choice of treatment, and there is no contraindication in the age or health of the patient, the operation should always be done. The same general principles apply in operating on lumbar hernia as in other hernias.

a. *Incision*.—The incision is usually made over the center of the tumor, beginning just below the twelfth rib and extending downward to the iliac crest. It should be long enough to give a free exposure so that all bleeding points can be seen easily and caught with pressure forceps. Because of the thinning of the tissues, there is less hemorrhage than in the ordinary operation for exposing the kidney.

b. *The Sac*.—The sac is never adherent to the skin. In large hernias it may be near the surface, but as a rule, it is covered by fat, and rarely by muscle. If it is not readily found the dissection should proceed very cautiously, as in many cases there is no sac, and only a mass of subperitoneal fat which may represent the mesocolon, is in its place. It is well to remember the experience of Turner, who found the colon immediately beneath the subperitoneal fat, and tore the outer coat in his search for a sac that did not exist. The posterior part of the colon was not covered by peritoneum, and it had evidently become loosened from its attachments by the protrusion and retraction through the hernial opening, which accounted for the cavity felt at examination.

c. *Fatty Hernia*.—When the hernia consists only of a mass of subperitoneal fat, the pedicle is ligated, the tumor excised, the edges of the aponeurosis overlapped, and the opening closed with interrupted or mattress sutures of chromic catgut.

d. *Closing the Hernial Opening*.—Small hernial openings can be closed with a pursestring suture and an overlapping of the fascia, as is done with small ventral hernias. It is sufficient to invert the sac without removing it, while in large hernias, it is best to resect the sac. In Campora's case the tumor was the size of a hen's egg, and he was able to suture the fascia of the erector spinae and quadratus lumborum to the internal oblique.

Large Hernial Openings.—Because small lumbar hernia is not troublesome, patients do not often seek treatment until the hernia is large, when it has become difficult to bring the muscular and fascial layers together over the orifice of the hernia. Often it is possible to detach a portion of the latissimus dorsi or external oblique muscle, and bring it over the opening and suture it. Küster closed the orifice with a skin, muscle, and bone flap. Owen, in 1888, was the first to excise the sac and close the wound with buried sutures. Bull overlapped the muscle and fascia using kangaroo tendon.

Dowd first turned up a flap made of fascia lata and the aponeurosis which overlies the gluteus maximus and medius. This flap was sutured to the lumbar fascia, the external oblique and latissimus dorsi muscles. The opening still remaining at the upper part of the wound was narrowed still more by suturing together the edges of the external oblique and the latissimus dorsi muscles. These last sutures were further reenforced by a flap from the aponeurosis of the latissimus dorsi muscle, which was turned for-

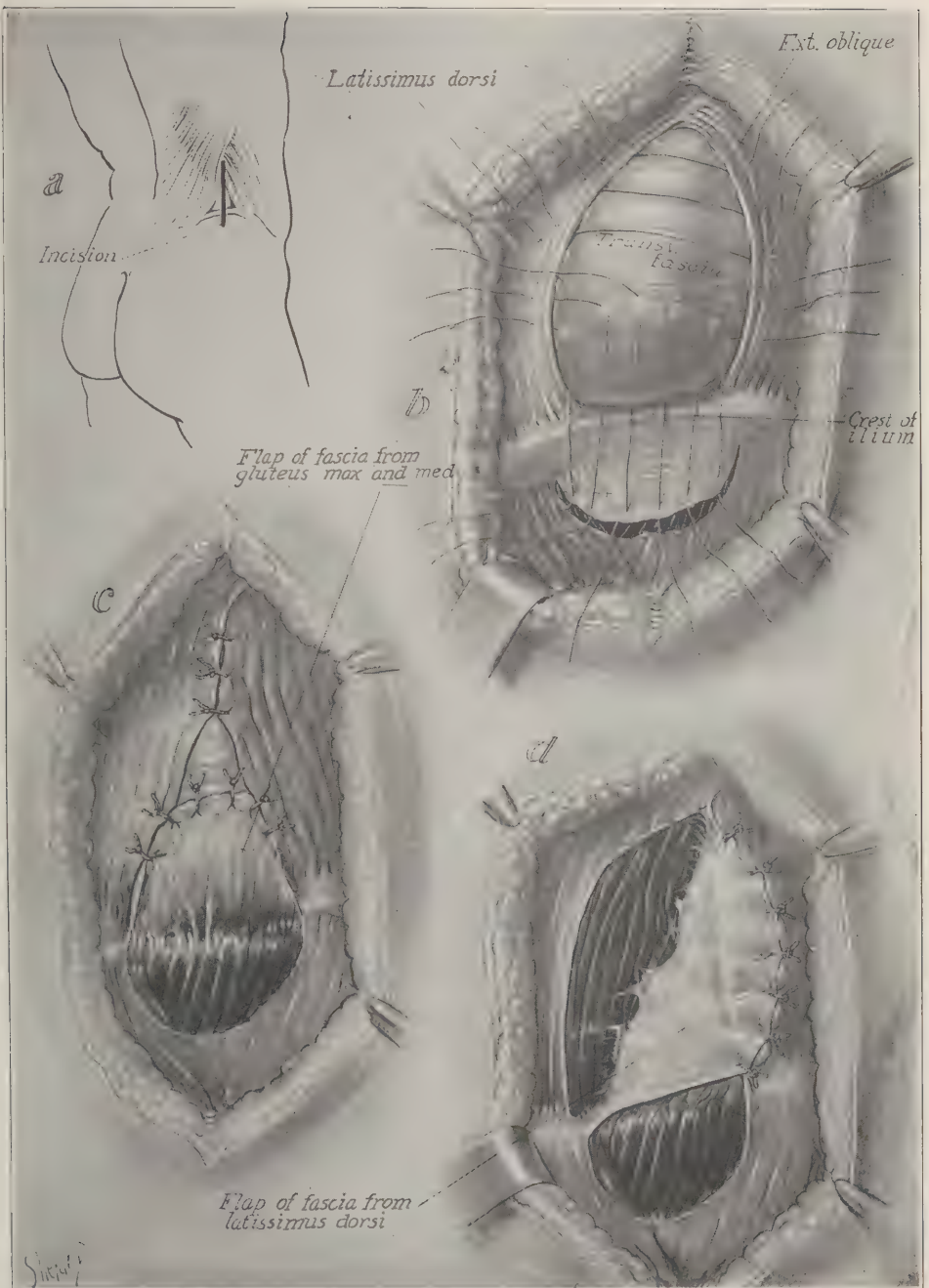


Fig. 184.—Dowd's operation for lumbar hernia. (a) The line of incision. (b) Turning up a flap of fascia lata and aponeurosis of the gluteus maximus and medius muscles, and suturing it to the lumbar fascia, external oblique, and latissimus dorsi muscles. (c) The flap sutured. (d) Closing the remaining gap with a flap of fascia from the latissimus dorsi.

ward and sutured to the aponeurosis of the external oblique. The patient had no recurrence. (Fig. 184.)

Rishmiller closed the opening with a flap made by splitting the anterior border of the aponeurosis of the latissimus dorsi. The crest of the ilium was roughened in order to favor soft tissue attachment. Interrupted sutures of chromicized catgut were used to approximate the internal oblique to the inner split half of the aponeurosis of the latissimus dorsi. A flap made from the outer split half of the aponeurosis of the latissimus dorsi, was turned over the unenclosed arched area just above the ilium and sutured. The superficial fascia was overlapped double-breasted fashion. Primary union resulted and there was no recurrence.

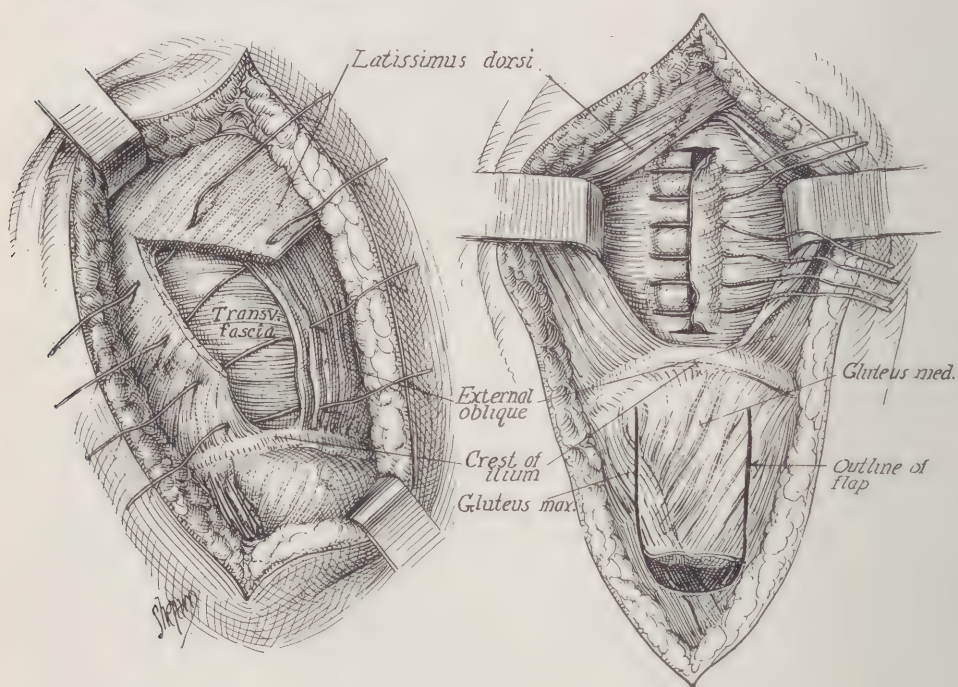


Fig. 185.

Fig. 186.

Operations for lumbar hernia.

Fig. 185.—Rishmiller's method of closing the opening by a flap obtained by splitting the latissimus dorsi and overlapping the superficial fascia.

Fig. 186.—Closing the opening by overlapping flaps of transversalis fascia, and reinforcing the suture line with a flap turned up from the fascia below the crest of the ilium.

In Turner's case, the opening which was five finger-breadths in width, was difficult to close on account of the tendency of the fascial edges of the aperture to tear and split. He finally succeeded in closing by mattress sutures. He believed the quadratus lumborum could be used to advantage in closing the gap.

Hancock emphasizes the importance of overlapping and suturing the

fascia which forms the floor of the triangle, before any attempt at closing the gap in the muscles.

An excellent method is to overlap freely the flaps of the transversalis fascia. Longer flaps can be secured by crossing the flap incision at either end by short transverse incisions. If the gap is large, a flap of fascia is turned up from below the crest of the ilium. The muscles are brought together and the superficial fascia sutured. (Figs. 185 and 186.)

Strangulated Lumbar Hernia.—Operation should be done immediately without attempting taxis. The hernia should be well exposed and dealt with as in strangulation elsewhere.

Bibliography

LUMBAR HERNIA

- BALIN: *L'art de guérir les hernies ou descentes*. Paris, Herissant, 1768, pp. 262-264.
- BARACZ, R.: Ueber die Lumbalhernien und seitliche Bauchhernien (Laparocelen). *Arch. f. klin. Chir.*, Berl., 1902, lxxiii, 631-657.
- BARACZ, R., AND BURZYNSKI, A.: Ueber die Lendengegene mit besonderer Berücksichtigung der Durchtrittsstelle der Lendenhernien. *Arch. f. klin. Chir.*, Berl., 1902, lxxiii, 658-677.
- BARBÉ: *De la paroi abdominale postérieure*. Montpellier, 1896.
- BARBETTE, P.: *Opera chirurgico-anatomica*. Lugduni, J. à Gelder, 1672, p. 26.
- BAYER, K.: Ein Fall von Hernia lumbalis in Rhombus Lesshafti. *Centralbl. f. Chir.*, Leipz., 1888, xv, 686-688.
- BLANCARD, S.: *Opera medica, theoretica, practica et chirurgica*. Lugduni, C. Boutestein et J. Lugtmans, 1701, ii, 385-393.
- BORCHARDT, M.: Ueber Lumbalhernien und verwandte Zustände. *Berl. klin. Wehnschr.*, 1901, xxxviii, 1221-1226; 1259-1262.
- BRAUN, H.: Die hernia lumbalis. *Arch. f. klin. Chir.*, Berl., 1879, xxiv, 201-228.
- BUDGEN, J.: A remarkable conformation of the urinary parts. *Phil. Tr.*, Lond., 1729-30. xxxvi, No. 410, ii, p. 138-139, Febr. 3, 1728.
- BULL, W. T.: See Coley, W. B.: Probable lumbar hernia. *Ann. Surg.*, Phil., 1895, xxii, 272-273.
- CAMPORA, G.: L'ernia lombare. *Gazz. d. osp.*, Milano, 1917, xxxviii, 513-518.
- CHARPY, A.: Aponéuroses de l'abdomen. In: *Traité d'anatomie humaine*. Poirier, P. et Charpy, A. 2nd ed., Paris, Masson, 1900, ii, 459-460.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.
- DEMOULIN, A.: Contribution à l'étude des hernies lombaires. *Courrier méd.*, Par., 1901, li, 273.
- DOLÉ, J.: *Encyclopedia chirurgica rationalis (etc.)* Francofurti, 1703, p. 326.
- DOWD, C. N.: Congenital lumbar hernia, at the triangle of Petit. *Ann. Surg.*, Phila., 1907, xlv, 245-248.
- DE GARENGEOT, R. J. C.: *Traité des opérations de chirurgie*. 1731, i, 369-371.
- GOODMAN, E. H., AND SPEESE, J.: Lumbar hernia. *Ann. Surg.*, Phila., 1916, lxxiii, 548-560.
- GRANGE, J.: Contribution à l'étude de quelques variétés de hernies rares au point de vue de leur siège. Thèse, Lyon, 1896.
- GRYNFELT, J.: Quelques mots sur la hernie lombaire. *Montpellier méd.*, 1866, xvi, 329-347; 504-526.
- HANCOCK, T. H.: Report of a case of traumatic hernia in Petit's triangle. *South M. J.*, Birmingham, 1920, xiii, 521-523.
- HEUERMANN, C.: Bemerkung von einem Lendenbruch (etc.). Kopenhagen und Leipzig, 1767, ii, 135.
- HUME, G. H.: Case of strangulated lumbar hernia. *Brit. M. J.*, Lond., 1889, ii, 73.
- HURLEY, J. R.: A case of lumbar hernia. *Mil. Surg.*, Carlisle, 1908, xxii, 306-307.
- HUTCHINSON, J.: On lumbar hernia. *Brit. M. J. Lond.*, 1889, ii, 71-73.
- JABOULAY, M., AND PATEL, M.: Hernies. XXV *Nouveau traité de chirurgie*. Le Dentu, A. et Delbet, P., Paris, J. B. Baillière, 1908.

- JEANNEL, M.: La hernie lombaire. Arch. prov. de chir., Par., 1902, xi, 389-418; 521-538; 649-665; 713-729; 1903, xii, 91-115; 159-174; 281-296.
- KÜSTER, E.: See Sultan, G.: Abdominal hernias. English transl. by W. B. Coley. Phila., W. B. Saunders Co., 1902, p. 265.
- LEJARS, F.: Hernie lombaire étranglée. Assn. franç. de chir. Proc. verb. (etc.), Par., 1905, xviii, 357-358.
- LESSHAFT, P.: Die Lumbalgegend in anat. chirurgischer Hinsicht. Arch. f. Anat. u. Physiol., u. wissensch. Med., Leipz., 1870, xxxvii, 264-270.
- LIEBER, J. W. B.: Ueber einen Fall von Lumbalhernie. I. D., Berlin, 1887.
- LUSCHKA, H.: Die Anatomie des Menschlichen Bauches. Tübing., H. Laupp, 1863, p. 38-43.
- MACREADY, J. F. C. H.: A treatise on ruptures. Lond., Griffin & Co., 1893.
- MARMISSE, G.: Hernie ventrale. Gaz. d. hôp., Par., 1862, xxxv, 170.
- MORESTIN, M. H.: Hernies graisseuses à travers la gaine aponéurotique de la masse sacro-lombaire. Bull. et mém. Soc. anat. de Par., 1901, iii, 202-205.
- MONRO, A.: The morbid anatomy of the human gullet, stomach and intestines. Edinburgh, G. Ramsay & Co., 1811, p. 379.
- OWEN, E.: Lumbar hernia; radical operation; recovery. Brit. M. J., Lond., 1888, i, 957-958.
- PETIT, J. L.: Traité des maladies chirurgicales, et des opérations qui leur conviennent. Paris, T. F. Didot, 1774, ii, 256-258.
- PLENCK, J. J.: Lehrsätze der praktischen Wundarzneiwissenschaft. Wien, 1774, J. Grasser, pt. i, p. 245.
- RAVATON, H.: Traité des plaies d'armes à feu., 1750, p. 277.
- RENEAULME DE LAGARENNE: Discours d'ouverture de l'École de chirurgie: Essai d'un traité des hernies nommées descentes, Paris, 1726, p. 91. Traduction d'une thèse latine médico-chirurgicale, soutenue aux écoles de Médecine de Paris le 8 avril, 1721.
- RISHMILLER, J. H.: Hernia through the triangle of Petit. Surg., Gynec. & Obst., Chi., 1917, xxiv, 589-591.
- ROCHARD, E.: Les hernies, Paris, O., Doin, 1904.
- RUIZ, J.: Hernia lumbar, Ó costoilíaca, congenita. Gac. méd. de Carácas, 1915, xxii, 179.
- TURNER, W. Y.: Lumbar hernia. Brit. M. J., Lond., 1917, ii, 389.
- WYSS, O.: Ueber Hernia ventralis lateralis congenita und ihre Beziehungen zur Hernia lumbalis. Beitr. z. Chir. Festschr. Theodor Billroth. Stuttg., 1892, p. 1-21.

CHAPTER XX

OBTURATOR HERNIA

Synonyms.—Hernia foraminis ovalis (de Garengéot); Hernie sous-pubienne; Anterior iliac hernia (Hesselbach); Thyroidal hernia (Cooper); Opeocele.

Definition.—An obturator hernia is one that passes through the obturator foramen or canal in the os innominatum.

Historical

The first case of obturator hernia was observed by Arnaud de Ronsil, in 1724, and reported to the Royal Academy of Sciences in Paris. The members denied the existence of such a hernia and refused to approve his findings. Two years later Duverney found a case of double obturator hernia in the pelvis of a woman that he had dissected; each sac contained intestine, and the tumor was the size of an egg. According to Ilöenel, obturator hernia was described by Le Maire in 1718, and was demonstrated in Berlin in 1734 by Cassebohm. However, de Garengéot was the first to make a thorough study of this subject. In 1743 he read a paper before the Royal Academy of Surgery in Paris, reporting a case he had observed in 1733, and six others collected from the literature. Camper described the anatomy of this variety of hernia in 1762, and noted the tendency of the peritoneum to form a diverticulum in the obturator foramen.

In 1768 G. Arnaud, the son of Arnaud de Ronsil, reported a case of strangulated obturator hernia in which he succeeded in reducing the intestine by taxis, only a small lump remaining irreducible. He made an incision over the tumor, and found a piece of strangulated omentum which he cut away along with a portion of the sac, and pushed the remaining part of the sac back into the obturator canal. This was the first patient successfully operated on. In 1744 Günz saw an obturator hernia of the bladder. Dupuytren, in 1819, diagnosed an obturator hernia, reduced it, and the patient recovered.

In preantiseptic days, the obturator route was used on account of the many dangers and high mortality surrounding intraabdominal operations. Laparotomy for strangulated obturator hernia was first used by Hilton in 1848, by Coulson in 1863, and by Godlee in 1885. Their patients died, and the operation fell into temporary disrepute.

Because of the usual absence of a tumor, obturator hernia has always been misleading; and until recent years, diagnosis was practically never made except in case of strangulation, or at autopsy. A majority of the cases of strangulated hernia were diagnosed during the course of operations for intestinal obstruction. Meyer observes that with the advent of antiseptic surgery, there were as many strangulated obturator hernias cured in the ten years following 1875, as were cured in the hundred and fifty years preceding. Important papers have been published by Schmidt, Pimbet, Picqué and Poirier, Auerbach, Berger, Gladstone, Meyer, Fredet, and Sträter.

Englisch, in 1891, was able to collect from the literature 135 cases of obturator hernia; Jaboulay and Patel in 1899 found 35 additional cases. In 1909 Corner and Huggins stated that the total number of cases reported exceeded 250. In the last few years, several cases have been diagnosed without operation, and the number of cases reported is increasing each year, so that the condition is no longer considered a rarity.

Statistics

I have collected from the literature 396 cases of obturator hernia up to 1923.

Age.—In 258 cases the ages of the patients were given as follows:

Under 10 years	0
11 to 20 years	3
21 to 30 years	9
31 to 40 years	20
41 to 50 years	30
51 to 60 years	51
61 to 70 years	83
71 to 80 years	49
81 to 90 years	13
	258

Sex and Site.—In 297 cases the sex, or the site of the hernia, or both, were given as follows:

NO. CASES	MALES				FEMALES				SEX NOT GIVEN	
	R.	L.	BILAT- ERAL	SIDE NOT GIVEN	R.	L.	BILAT- ERAL	SIDE NOT GIVEN	R.	L.
297	14	18	5	7	104	95	16	29	4	5

Duration of Strangulation.—In 171 cases the duration of the strangulation was given; that is, the amount of time that passed before the patient was relieved by taxis or operation, or before death:

1 day	14
2 days	11
3 days	26
4 days	25
5 days	19
6 days	16
7 days	10
8 days	21
9 days	5
10 days	5
11 days	3
12 days	2
13 days	0
14 days	6
15 days	4
16 days	1
21 days	2
28 days	1
	<hr/>
	171

Sac Contents.—In 125 cases the sac contained the small intestine, and in 37 cases the large intestine. Among the viscera found in the sac were the ileum, jejunum, colon, sigmoid, cecum, appendix, omentum, bladder, ovary, fallopian tube and uterus. In one hernia there was a volvulus of the small intestine of 360° , and one of 180° in another case. In one case of hernia of the colon there was a 360° torsion of the colon in the abdomen above the neck of the sac.

Diagnosis.—Of the 228 patients who were treated by operation or who died of strangulation without operation, a diagnosis previous to operation or autopsy was made in only 53.

Howship-Romberg Sign.—The Howship-Romberg sign was noted in 68 cases. In many of these, the diagnosis was not made even with this characteristic sign present.

Results of Treatment.—In this series of 396 cases the final results were given in 228 as follows:

Operation followed by recovery	77
Operation followed by death	72
Death, no operation	79

In 64 patients reported between 1910 and 1923, three died of strangulation without operation; 61 were operated on and of these 23 died (37.7 per cent) and 38 recovered (62.3 per cent).

In 12 cases the first operation was done for a supposed strangulation of an inguinal or femoral hernia or intestinal obstruction, and a second operation later, with the result that 11 of these patients died and one survived.

Anatomy

The obturator foramen is covered by an aponeurosis of interlacing fibers called "the internal obturator membrane" which is attached externally to the margin of the foramen; internally to the posterior surface of the ischiopubic

ramus, below and internal to the margin of the foramen. The obturator membrane is sometimes deficient above, where the obturator vessels and nerve leave the pelvis along the subpubic groove, which runs obliquely inward and downward. The obturator membrane is reenforced anteriorly by a fibrous lamina, which has its origin in the transverse ligament of the acetabulum and runs directly inward parallel to the horizontal ramus of the pubis. It is attached to the pubic bone and the lower part of the obturator membrane; this is the subpubic fascia of Testut, or the external obturator membrane. The result of this arrangement is that the two obturator membranes joined below are separated above; in this arched space hernias may lodge.

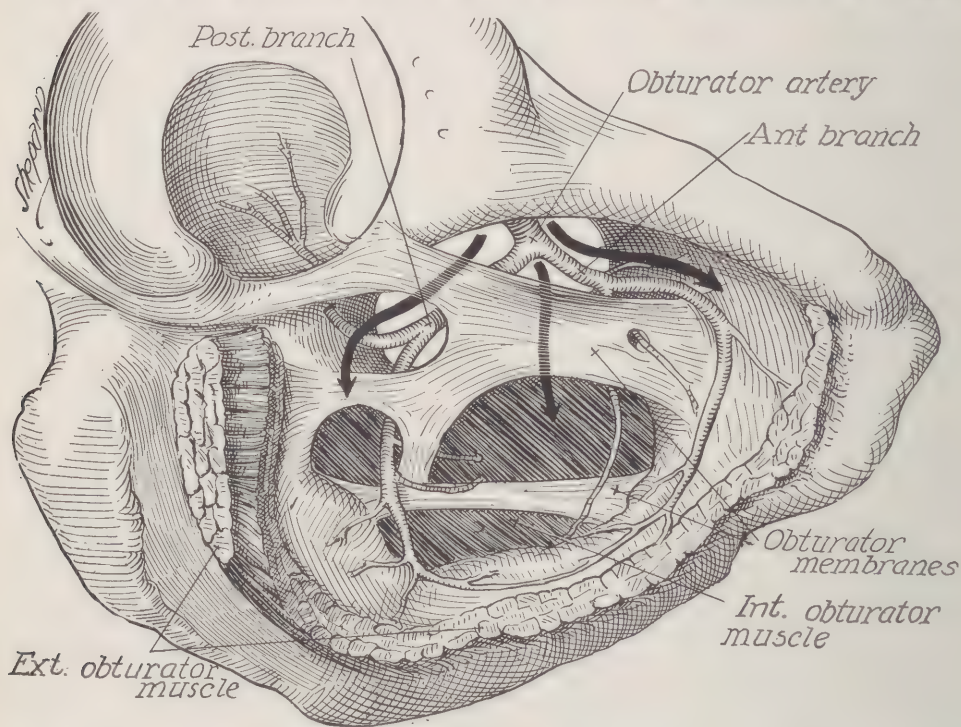


Fig. 187.—The anatomy of obturator hernia. Showing the obturator membranes, the vessels, and the course taken by the different varieties of obturator hernia.

The internal obturator membrane is attached to the internal obturator muscle and forms a strong fibrous sheet with only one opening at its upper anterior portion for the passage of the vessels and nerve. The external obturator membrane, which is attached to the external obturator muscle, may present irregular openings or it may be fenestrated. (Fig. 187.)

The Obturator Canal.—The obturator canal gives passage to the obturator vessels, the nerve, and occasionally to an obturator hernia. It runs obliquely downward and forward, measuring from $\frac{1}{4}$ of an inch to $1\frac{1}{2}$ inches (2 to 3 cm.), and is in the form of a triangle with the base above. Its superior wall is formed by the obturator groove; its posterior wall is formed by the

internal obturator membrane, reenforced by the obturator muscle; and its anterior wall is formed by the external obturator membrane and muscle. This anterior wall may present several orifices in the fascia or muscle through which a hernia may make its exit.

The internal orifice is formed above, by the bony margin of the ascending ramus of the os pubis, and below by the sharp edge of the internal obturator membrane. It is firm and unyielding, hardly admitting the index finger, and is the usual cause of strangulation in this region. This orifice is covered by the parietal peritoneum which is usually only slightly movable, and beneath it, compact subperitoneal tissue is found.

The structures which normally pass through the obturator canal in order of superposition are, the obturator nerve, artery and vein. External to the pelvis and beneath the obturator externus muscle, the nerve, artery and vein each divide into an internal and external branch. Any of these openings can serve as a hernial passage. The obturator region is covered in part by the obturator externus and pectineus muscles. (Figs. 188 and 189.)

The Hernial Openings.—The best classification of obturator hernias is that of Picqué and Poirier, which divides them into three varieties, according to their location:

a. *In the obturator canal.*—This variety enters at the internal opening or internal orifice and passes out through the external orifice, accompanied by the internal branches of the obturator nerve, artery and vein. It is in front of the external obturator muscle, and is covered by the pectineus muscle. (This is the most frequent type of obturator hernia.)

b. *Between the middle and superior fasciculi of the external obturator muscle.*—This hernia enters at the internal orifice and follows downward the route of the inferior branches of the obturator nerve, artery and vein. The hernia passes between, and is held by the upper and middle fasciculi of the obturator externus muscle.

c. *Between the external and internal obturator membrane.*—The hernia enters the internal opening of the canal and passes downward between the internal and external obturator membranes. It is behind, and covered by the external obturator muscle. In operating for this type of hernia, after the pectineus is separated, it is necessary to go through the obturator externus muscle to reach the hernia.

The Sac.—The sac is formed by peritoneum and is forced downward into the canal by intraabdominal pressure. Small lipomas sometimes favor the descent of the sac; Gerdes found a large lipoma in front of a hernial sac. Fredet calls attention to the occasional existence of a double sac.

a. *The size of the sac.*—Because of the narrowness of the obturator canal and the resistance offered by the obturator externus and pectineus muscles, the hernia is usually small and seldom palpable. Large hernias are very rare. One has been reported by Mason, and Bérard saw one the size of an adult's head.

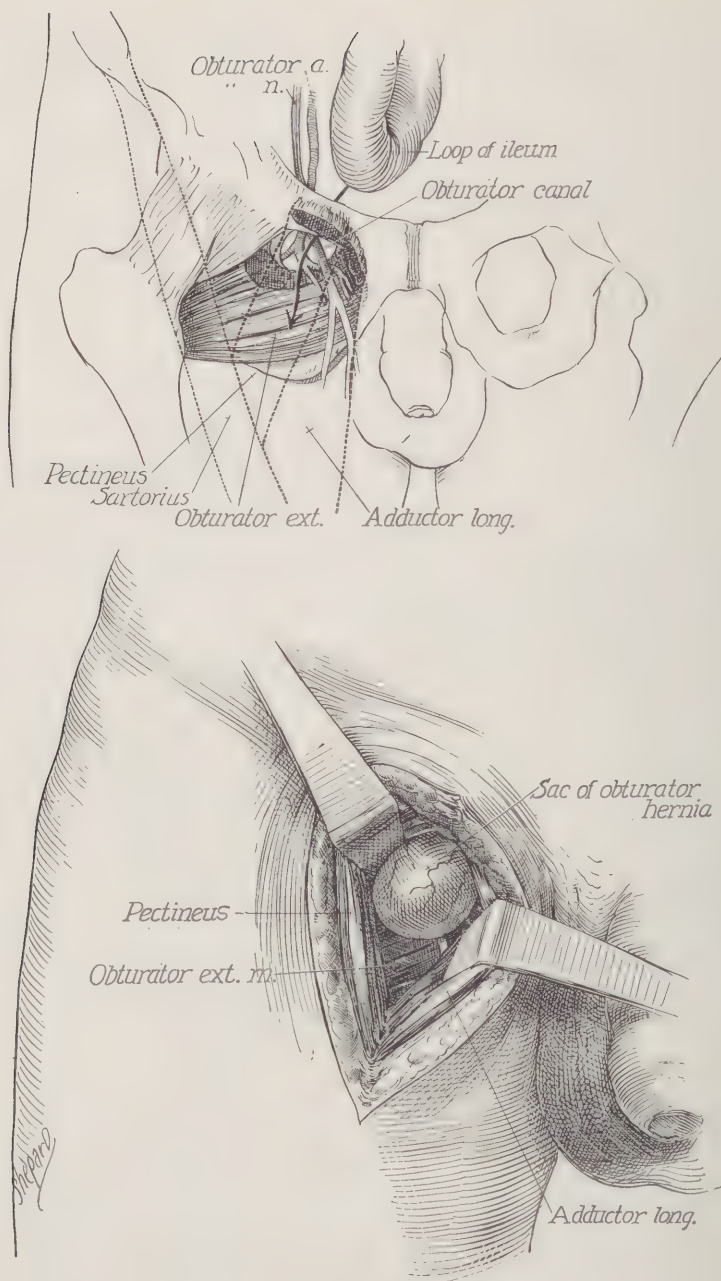


Fig. 188.

Fig. 189.

The anatomy of obturator hernia.

Fig. 188.—The structures passing through the obturator canal in the order of their superposition, behind the hernial sac, are: The obturator nerve, artery and vein.

Fig. 189.—Hernia in the obturator canal. This is the most frequent type of obturator hernia. The sac lies on the obturator externus muscle and is covered by the pectineus. The obturator nerve is seen directly behind the sac.

b. *Contents of the sac.*—Small intestine is usually the sole content of the sac; omentum is seldom present. Partial strangulation or Richter's hernia is common.

There are a few cases on record in which the ovary and fallopian tube have been found. The non-gravid uterus has been observed as in Krönlein's case in a woman, aged 70, who was operated on for strangulated right obturator hernia. The sac contained a coil of small intestine, the right ovary and tube, and the greater part of the uterus.

A portion of the bladder has been found a few times; the appendix is a rare content. In Bary's case there was a painful mass over the pectineus and adductor muscles, which gradually became larger and fluctuating. Operation was refused and the patient died; at autopsy an abscess was discovered beneath the pectineus and adductor muscles. The obturator foramen was large enough to permit the index finger to pass through, and the obturator sac was filled with pus and contained an appendix $4\frac{1}{2}$ inches (11.2 cm.) long, which was perforated at its tip. The most probable explanation for the presence of these organs in obturator hernial sacs is found in the fact that they normally lie in close proximity to the internal opening, and any relaxation or elongation on the part of their supporting structures allows them to slip through an enlarged obturator opening. Rochet saw an abscess of the hernial sac come to the surface in Scarpa's triangle.

Relation of the Hernia to Nerve and Vessels.—The nerve and vessels run between the peritoneum and transversalis fascia.

a. *The artery.*—The position of the artery is variable. It is usually behind the neck of the sac and to its outer side. Englisch found that the position of the obturator artery was mentioned in 28 cases; it lay to the outer side of the sac in 13 cases, behind it in 9, and to the inner side in 6. These are probably hernias of the first variety, with the sac situated anteriorly and internal to the artery, if the latter comes from the internal iliac, which is its usual origin. In this variety the sac rests upon the vessels, while in the second and third varieties the vessels usually rest on the sac.

On account of the anastomosis between the epigastric and obturator arteries, there is often an arterial leaf circle around the neck of the sac. These vessels are small and of little importance, when the obturator comes from the internal iliac, and the epigastric from the external iliac. When a branch of the deep epigastric artery replaces the obturator artery, the vessels are in a dangerous position.

In about 10 per cent of all cases an abnormal obturator artery passes inward in front of the femoral ring, then arches downward to the inner side of the ring and lies on Gimbernat's ligament. The operator should be on the lookout for the artery in this dangerous position when operating for strangulated femoral hernia, so as to avoid dividing it accidentally. It is not very unusual to find a complete arterial circle around the neck of the sac, as in the case described by Borek.

b. *The nerve*.—The obturator nerve is usually on the outer side of the sac and above the artery which it accompanies. Sometimes the nerve is separated from the artery by fascia; when this happens it is usually due to pressure of the hernial sac. According to Jaboulay and Patel, when the obturator nerve leaves the canal it expands into a trellis-like network which delays the progress of the hernia, and often the nerve fibers can be seen holding back the hernial sac. Fredet saw a case in which a branch of the obturator nerve made a furrow on the external surface of the sac, and he advanced the ingenious hypothesis that as a hernia increased in size the nerve was displaced to one side, and as the pressure was removed from the nerve, the referred pain along the course of the nerve disappeared. While the nerve is usually on the outer side of the sac, it may be in front, or rarely behind, or to the inner side of it. Macready states that in 21 cases the nerve was behind the sac 3 times and on the inner side twice.

The downward course of a hernial sac may be arrested by a branch of the obturator nerve, usually the anterior one. The traction on this nerve may cause pain, and even symptoms of paralysis, referred down the inner side of the thigh to the knee. These symptoms disappear as the sac emerges from the foramen, and leaves the nerve behind it. In some instances, the nerve offers such resistance that the hernial sac is diverted from its direct course, and lodges behind the obturator externus muscle. The nerve sometimes circles partly around the neck of the sac. In the pelvis, it is outside and above the neck, while external to the obturator foramen it lies below the sac.

Etiology

Predisposing Causes.—Sex.—Obturator hernia occurs six times more frequently in women than in men. Pregnancy is an important factor, because it sometimes leaves the parietal peritoneum relaxed. Another cause in women, is the larger pelvis which inclines more obliquely than in men, and the relatively larger size of the obturator foramen. The transverse diameter of the obturator foramen is nearly always greater in women than in men; in men the average is $1\frac{2}{5}$ inches (3.5 cm.), while in women it is $1\frac{3}{5}$ inches (4 cm.) in 50 per cent of the cases, and it is more oval in shape in women than in men.

Relative frequency in men and women:

Berger	118 cases	18 men	15.25
Lillotte	90 cases	7 men	7.77
Pimbet	73 cases	8 men	10.95
Thiele	26 cases	2 men	7.69
Meyer	56 cases	4 men	7.14
Watson	288 cases	44 men	15.27

Age.—As a rule, obturator hernia occurs earlier in men than in women, though it is very rare in either sex under 50 years of age. The youngest

patient recorded was 12 years old. Of the 396 cases I collected, the ages were given in 258:

Between 11 and 20	3
Between 21 and 30	9
Between 31 and 40	20
Between 41 and 50	30
Between 51 and 60	51
Between 61 and 70	83
Between 71 and 80	49
Between 81 and 90	13

Emaciation.—Trélat, in 1872, was among the first of the earlier writers to remark upon emaciation as a cause of obturator hernia. Loss of weight causes a shrinkage of the fatty tissue in the obturator canal, thus favoring the entrance of a hernia. Fifty-five per cent of the cases of obturator hernia on record have occurred in women between 61 and 80 years of age who were very thin, often from recent loss of weight.

Congenital Predisposition.—Congenital predisposition is a factor in obturator hernia. The obturator foramen has been examined frequently in the dissecting room, and also in the course of laparotomies. Sometimes there is an opening, with a pouching of the peritoneum through the obturator canal, that, in some instances is large enough to admit the tip of the finger, but there is no evidence of hernia.

Other Causes.—Other predisposing causes are, chronic bronchitis, emphysema, and laborious occupations. Vinson believes that pelvic peritonitis may favor the later development of an obturator hernia. Pimbet mentions previous attacks of ascites which may have left the obturator canal patulous, thus favoring the formation of a hernia.

Accidental Causes.—Often the cause of obturator hernia is unknown. Sometimes it is due to direct injury. For instance: Lifting a weight, a fall from a height, or a crushing blow; or it may be due to indirect causes, such as straining at stool, coughing, or sudden exertion. Rarely its onset is coincident with the appearance of an inguinal or a femoral hernia.

Tonking reported a case in a man, who, while at work lifting weights, felt severe pain in the abdomen, accompanied by vomiting, prostration and marked shock. At operation it was found that a strangulated obturator hernia had reduced itself spontaneously *en masse* and was free in the abdominal cavity. Elder reported a case of a woman, 73 years old, who, after a misstep, noticed a severe pain across the lower half of the abdomen. Symptoms of obstruction were present, and operation disclosed a strangulated partial enterocele in the obturator canal.

Symptoms and Diagnosis

Reducible Obturator Hernia.—When there is no tumor, small reducible obturator hernias are seldom diagnosed unless they are accompanied by gastrointestinal symptoms, or pain along the course of the obturator nerve.

The point of exit is deeply placed, and the hernia usually descends between the obturator externus and pectineus muscles, and lies beneath the adductor longus and pectineus. The hernia must be large to be palpable, and should always be felt for on the inner side of the thigh. There may be a slight, poorly defined, tender swelling, located below and internal to the femoral opening, which suggests vaguely the signs of a reducible hernia. Sometimes the patient can feel the hernia slip out and is easily able to reduce it himself, as in the case reported by McMahon. Large reducible obturator hernia is very rare. There are only a few cases reported in the literature, such as those observed by de Garengot, Bérard, and Mason.

Gastrointestinal symptoms that may be present are: Constipation, occasional attacks of nausea, vomiting and colic.

In the case of double obturator hernia reported by Van Zwalenburg, the openings were approximately the same size, although during the attacks of colic the pain was more severe on the right side. At operation it was found that a mass of fat had partially occluded the left canal so that less intestine could enter it, and this probably accounted for the milder degree of pain on the left side.

Pressure on the obturator nerve may be manifested by numbness or cramps in the thigh or leg, which is relieved by changing position. This symptom is more often present and is more severe in strangulated hernia, but when it is found in reducible hernia, it is the most important symptom, and in some instances, it alone has led to a correct diagnosis.

Strangulated Obturator Hernia.—Strangulation in obturator hernia is very frequent because of the unyielding nature of the internal opening of the obturator canal—the bony wall above and the sharp edge of the firm inelastic internal obturator membrane below. The point of constriction is almost always at the neck of the sac, where it is pinched by the internal obturator membrane. Strangulation is occasionally caused by the external obturator membrane, or by intrapelvic constrictions.

The symptoms may be intermittent suggesting a partial enterocele, or continuous, pointing to a complete strangulation. When strangulation is complete, gangrene and perforation appear early. Partial enterocele frequently occurs, but unless the symptoms are sufficiently severe to necessitate operation, it is seldom diagnosed.

The Examination.—The examination should be made in a well-lighted room. Sometimes a slight bulge or fullness can be seen in the obturator region, when no tumor can be felt. With the patient in the dorsal position, the pectineus, adductor longus and obturator externus muscles are relaxed by flexing, adducting and rotating the thigh outward. With the patient in this position, a tumor or sensitive spot can almost always be felt if a hernia is present. It is painful, tense and irreducible. The hernia may sometimes be diagnosed by means of a rectal or vaginal examination. (Fig. 190.) In strangulation there is pain over the obturator region, which is increased

when the obturator externus muscle is put on the stretch by abducting and rotating the thigh inward.

Pressure on the Obturator Nerve.—Pain along the course of the obturator nerve is the most important symptom of obturator hernia, and is present in over 50 per cent of all cases. Attention was first called to it by Howship in 1840, and again by Romberg in 1845, and it is known as the Howship-Romberg sign. However, de Garengeot stated that in the case he observed in 1733, traction on the tumor *per vaginam* caused pain in the knee. The pain may

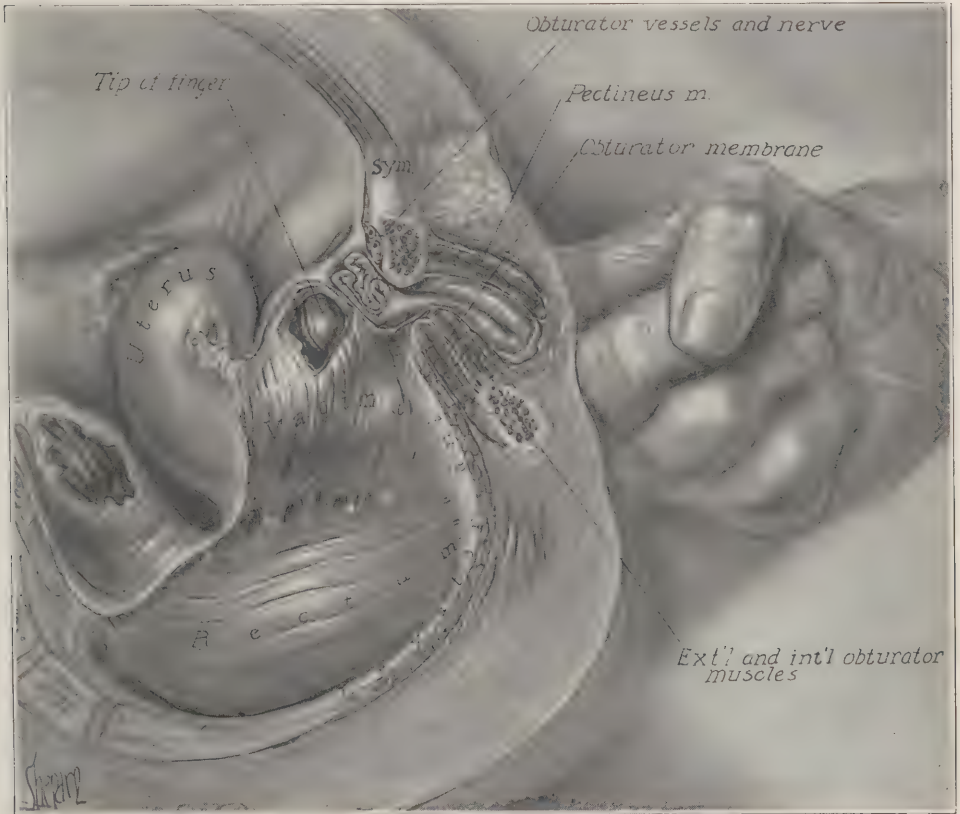


Fig. 190.—The anatomy and diagnosis of obturator hernia. Showing the relations of the sac to the obturator and pectineus muscles. The hernia can sometimes be felt as a tender mass at the obturator foramen by digital examination through the rectum or vagina.

be a dull ache extending down the inner side of the thigh to the knee, occasionally as far as the middle third of the leg, and rarely to the great toe. This symptom is most often noticed in strangulated hernia, and the pain is more severe than when the hernia is reducible. In a few instances, pain has radiated to the hip joint. The limb is usually kept in a semiflexed position and movement is painful. In others, it may take the form of a neuritis, varying in intensity from a mild prickling, tingling, burning sensation, to the severest of cutting and shooting pains. It is usually intermittent, and change

of position affords temporary relief. In a few cases it has been continuous in character and so severe as to result in partial paralysis of the extremities. This sign is absent when the nerve lies to the inner side of the sac, where it is free from pressure. When the nerve is dislocated or pushed out of the way by the advance of the sac, and the pressure removed, the sign of referred pain will be absent.

In the case reported by Milligan, the patient complained of pain in the right thigh over the inner portion of Scarpa's triangle, with indefinite tenderness over the inner and upper portion of the pectineus muscle. These symptoms were aggravated many times during the day, and once or twice at night, by any sudden turning of the leg outward while the patient was asleep. Van Zwalenburg's patient could assume the knee-chest position for a few minutes, thereby relieving the colicky symptoms, the referred pain along the course of the obturator nerve, and the tenderness in the obturator region.

Marshall's patient complained of a burning pain, increasing to a stinging ache, which was referred to the dorsum of the penis and down the inner side of the left knee, encircling the patella when at its worst. It was associated with localized tenderness over the obturator region and had been present for two years. It was usually relieved by walking, stooping and moving around, sitting down for 15-20 minutes and by lying in bed.

Stones' patient noticed a prickling, burning sensation in the right iliac region, radiating down the inner side of the right thigh. This pain, which had occurred several times during the two previous years and had lasted one or two days, was the only sign of obturator hernia until the sudden onset of obstruction.

Differential Diagnosis

In many instances obturator hernia is discovered during an operation for intestinal strangulation; in others, the symptoms are believed to be due to a femoral, inguinal, or umbilical hernia, or intestinal obstruction, which is operated on, while the strangulated obturator hernia is overlooked, and not discovered until a second operation for the unrelieved symptoms, or at autopsy. This happened in 12 of 396 cases of obturator hernia which I collected from the literature.

Obturator hernias are sometimes bilateral, or combined with other hernias in this region, especially femoral. In both Olivares' and Rischbieth's patients the obturator hernia was complicated by sciatic hernia. Both obturator canals should always be examined. Rarely there is a strangulated obturator hernia on one side, and a nonstrangulated one on the other; several cases of double obturator hernia are on record.

Femoral hernia.—Obturator hernia is more frequently mistaken for femoral hernia than for any other variety. The obturator hernia is below and internal to the femoral opening, and comes from beneath the pectineus.

In femoral hernia the Howship-Romberg sign is absent, and bimanual examination shows the obturator canals are free. The patient reported by McMahon, gave a history of obturator hernia for four years, which he could reduce previous to the occurrence of strangulation. In spite of the typical symptoms, a positive diagnosis could not be made until laparotomy was performed.

Perineal hernia.—Perineal hernia makes its exit below the arch of the pubes, and as its course is different, there is little chance of confusing it with obturator hernia.

Adenitis.—Adenitis may rarely occur in the obturator region, but the presence of other enlarged glands will serve to exclude obturator hernia.

Psoas Abscess.—Psoas abscess appears above the pectineus, and is soft, fluctuating and painless, and the history serves to distinguish it from obturator hernia. Pimbet mistook an abscess situated beneath the pectineus muscle for a strangulated obturator hernia.

Varicose Veins.—A saphenous varix or arteriovenous aneurysm may occur in the obturator region, and the diagnostic signs are the same as when the condition is found elsewhere.

Pain Along the Course of the Obturator Nerve.—The Howship-Romberg sign is the most important symptom in the diagnosis of obturator hernia, but there are several other conditions in which it may occur. *Rheumatism* is infrequently confined to the inner side of the thigh, and there is often a history of involvement of other regions. The Howship-Romberg sign is sometimes mistaken for rheumatism in the elderly, and especially in those subject to it.

Neuralgia.—Simple neuralgia of the obturator nerve is rare; occasionally the anterior crural nerve is affected, and the pain and tenderness involve the front of the thigh as far as the knee, or follow the saphenous branch down the inner side of the leg as far as the great toe. Sometimes this is associated with sciatica—or neuralgia in other parts of the body.

Other Conditions.—In sacroiliac or hip joint disease, the first symptom may be pain on the inner side of the knee. Malignancy of the cecum and sigmoid, pelvic peritonitis and perimetritis, by pressure on the obturator nerve in the pelvis, may cause a referred pain down the inner side of the thigh. Krönlein observed a patient who had suppurative pelvic peritonitis with high fever and referred pain along the nerve. Landerer reported a case of osteomyelitis of the pubes with symptoms of partial obstruction and pain in the thigh which closely simulated strangulated obturator hernia. In rare instances the osteomyelitis is in the region of the obturator foramen and pre-operative diagnosis may be impossible.

Internal Hernia.—The history of recurrent attacks, which Meyer compares to the stages of "attack" and "interval" in chronic appendicitis, will help to distinguish a strangulated internal hernia from an obturator hernia.

Possibility of Making a Diagnosis.—In the series I studied, 228 patients were treated by operation or died from strangulation. Of these a diagnosis was made in only 53 (22.7 per cent).

Prognosis

The course of nonstrangulated obturator hernia is one of intermittent attacks of partial obstruction, which tends to become progressively worse, eventually ending in complete strangulation. The mortality of strangulated obturator hernia is high; therefore, the prognosis is always grave. Gangrene of the intestine occurs early and has been found in 25 per cent of the cases that have come to operation. As our knowledge of obturator hernia increases and we are able to make the diagnosis early, sometimes before strangulation occurs, the mortality rate is decreasing. In Graser's collection of 118 cases reported before 1890, the mortality rate was 78.81 per cent; Macready in 1892, placed it at 84.25 per cent; and Rose in 1893, gave it at 78.75 per cent. In my series of 228 patients that were treated with or without operation there were 151 deaths (66.3 per cent). Sixty-four of these were reported between 1910 and 1923. Three patients died without operation; 61 were treated by operation and of these 38 survived and 23 died (37.7 per cent). Recurrence is to be expected in about 10 per cent of the cases operated on by laparotomy. By the obturator route, this figure is a little higher, both for recurrence and mortality.

An operation for the relief of strangulated hernia should always be followed by a radical operation to close the obturator opening. Several instances are on record where the strangulation has recurred when the radical operation has been neglected. To lessen the tendency to recurrence the patient should be made to gain in weight.

Treatment

Simple Obturator Hernia.—In early times reducible obturator hernia was never correctly diagnosed, usually being mistaken for femoral hernia. The treatment consisted of a bandage, and in 1804 Cooper advocated the femoral type of spring truss, with an extra thick pad, to make firm pressure on the thigh. Bourgeaud devised a swimming trunk apparatus that had a small air cushion-pad which fitted over the obturator opening, and was held in place by an abdominal belt.

With our increased knowledge of the pathology of obturator hernia, we know that truss treatment is not safe, even if the truss fits and holds the hernia in position, because there is the ever-present danger of strangulation. McMahon's patient had worn a truss that was fairly comfortable and had held back the hernia for four years, before strangulation suddenly occurred. In many instances, the truss is uncomfortable and cumbersome, and the patient refuses to wear it. The radical operation should always be advised.

Strangulated Hernia.—*A. Taxis.*—It is always dangerous to attempt taxis, because gangrene sets in early and the danger of rupturing the intestine is great. Immediate operation without preliminary taxis is to be recommended. One of the earliest cases of strangulated obturator hernia that was treated by taxis was described by de Garengeot in 1743. After raising the pelvis and the knees, the tumor was rubbed from below upward, and the intestine slowly returned as the tumor, which was 5 to 6 inches (12.5 to 15 cm.) in length, gradually disappeared. The patient felt a gurgling sensation in the abdomen, and the pain and vomiting which had been present for three days suddenly ceased.

The best method of taxis is as follows: The patient's limb on the affected side is slightly flexed and everted so that the outer side of the knee rests lightly on the bed, and the pelvis is raised. While an assistant compresses the hernia, the physician, with one hand on the pubes, attempts to force back the intestine, and with a finger of the other hand in the vagina or rectum, endeavors to disengage the loop of strangulated intestine.

B. Operative Treatment.—There are two routes for operating on obturator hernia, the abdominal and the obturator, and in certain instances it is necessary to use both.

The Abdominal Route.—Laparotomy is the operation of choice, because it permits resecting the intestine in case there is gangrene, without the necessity of making a second incision which would be required if the obturator route were used. There are other advantages of the abdominal approach: It enables the operator to confirm the diagnosis promptly; it permits an easier reduction of a nonstrangulated hernia; it allows a safer handling of gangrenous intestine; there is less danger of accidental hemorrhage from the obturator artery, and the operation can be carried out more rapidly than by the obturator route.

The Operation.—The patient is placed in the Trendelenburg position. If there is any question regarding diagnosis, a median incision below the umbilicus is used. If the hernia has been definitely diagnosed, a lateral rectus incision is made on the same side as the hernia. All the possible sites of hernia are examined. The strangulated obturator hernia is located by following down the afferent and efferent loops of intestine, and the constricting ring gently stretched with the finger, a grooved director, or by inserting a hemostat and carefully spreading the blades. (Fig. 191.) If the artery can be plainly seen on the outer side of the opening, the constriction can be slightly nicked, downwards and inwards. Traction on the strangulated loop must be very gentle, as there is always danger of tearing gangrenous bowel. Eccles reported a case in which this accident occurred. While making gentle traction on the strangulated loop it suddenly gave way leaving a gangrenous opening in the intestine the size of a three-penny piece.

The strangulated loop is usually very small and reduction is aided by

having an assistant press over the pectineus muscle from the outside, while the operator makes traction cautiously to release the strangulation. If gangrene is probable, it is advisable to have the field walled off by compresses and intestinal anastomotic clamps placed on afferent and efferent loops of intestine. The strangulated loop of intestine, if viable, is returned to the abdomen; if the gangrenous area is small, it should be invaginated and closed over with interrupted Lembert sutures. Rawles reported a patient operated



Fig. 191.—Abdominal operation for strangulated obturator hernia. The point of constriction is located by following the proximal or distal loops of intestine down to the obturator foramen. Traction on the loop must be very gentle, as there is always danger of tearing the bowel, if it is gangrenous.

on successfully in whom a gangrenous area $\frac{3}{4}$ by $1\frac{1}{2}$ inches (2×3.7 cm.) was successfully inverted in this manner. If intestinal resection is necessary, an end-to-end anastomosis can be done, or if the condition of the patient is serious, the Murphy button can be used. The portion of intestine that has been inverted or resected, is covered over by a flap of omentum which is fastened in place by a few sutures; this lessens the dangers of leakage and adhesions.

The Sac.—The simplest treatment of the sac is to invert it, by seizing its lower end with a forceps and making traction. A ligature is placed around the base and the whole, or a part of the sac is resected, or several sutures can be passed through the sac and tied, and the plug thus formed is stitched over the obturator foramen. (Figs. 192 and 193.)

In case the sac cannot be inverted, as much of it as possible should be freed from the canal, and the edges sutured together to close the opening. Corner and Huggins reported a case in a woman who had three operations for recurrent strangulated obturator hernia. At the first two operations no attempt was made to close the opening on account of the poor condition of the patient; at the third operation the internal opening of the obturator canal was closed and there was no further trouble. A more radical method of closing the obturator opening is by means of an osteoplastic flap, such as described for large inguinal and femoral openings. Meer used this method

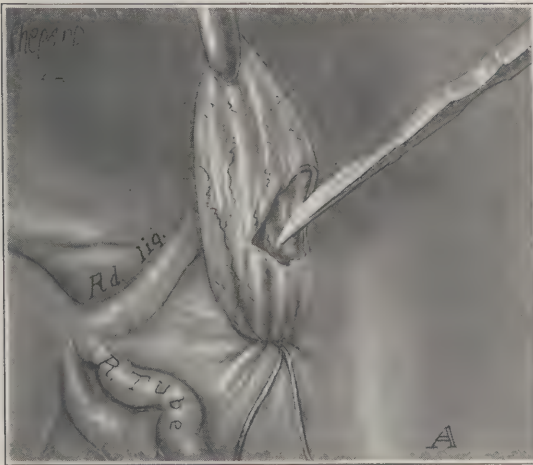


Fig. 192.



Fig. 193.

Abdominal operation for obturator hernia.

Fig. 192.—The sac is inverted and a ligature passed around its base; if the sac is large a part of it is resected.

Fig. 193.—The remaining portion of the sac is folded on itself to form a plug, which is fastened by interrupted sutures over the obturator foramen.

with good results, and Schwarzhild employed it successfully on a patient who had had two previous operations for strangulated obturator hernia. The osteoplastic flap was $1\frac{3}{4}$ inches (4 cm.) wide, and long enough to cover the opening. It was chiseled from the inner side and descending ramus of the symphysis pubis, and was turned down over the obturator opening and fastened by catgut sutures.

Obturator Route.—The obturator route is used less frequently than the abdominal, although it is still preferred by some operators. The pelvis of the patient is elevated on a sandbag and the thigh flexed and abducted. The femoral artery is located and at a point midway between the artery and

the spine of the pubis, an incision 3 or 4 inches (7.5 or 10 cm.) long is made, with its center over the tumor. According to Trélat, the incision should be 35 mm. internal to the femoral artery, which is about the same as Lejars' directions, of $1\frac{1}{2}$ inches (3.7 cm.) internal to the femoral artery. The subcutaneous tissue and fascia lata are divided. If the saphenous vein is in the way, it is divided between ligatures; at the upper edge of the adductor longus, the external pudic artery is sometimes encountered, and it can also be divided. The upper border of the adductor longus is retracted downwards and inwards. The pectineus muscle is located and the space between it and the



Fig. 194.—Operation by the obturator route. After the skin and subcutaneous tissues are divided, the hernia is exposed by retracting the pectineus muscle outward, and the adductor longus inward. The constriction can often be stretched sufficiently, by pulling downwards and inwards with the index finger, to permit the reduction of viable intestine.

adductor longus is opened; if this does not give a good exposure, the pectineus muscle can be cut transversely. The nerve will be found coming through above the obturator muscle or through its upper fibers.

The hernial sac must be opened and the contents inspected before the constriction is divided or the hernia reduced. If there is gangrene, laparotomy should be performed and the intestine treated from above. If the contents are viable, the constriction can be stretched by pulling downwards and inwards with the finger, or by introducing a closed hemostat and carefully separating the blades. (Fig. 194.) If this is not sufficient to permit

reduction of the hernia, it is necessary to incise the internal obturator membrane which is causing the strangulation. The artery should be located and the membrane cautiously nicked at a point where there is no danger of hemorrhage. The artery is usually behind and below, but sometimes it is in front, and rarely an arterial circle may surround the obturator opening. The constriction must never be divided until the artery is felt or seen; serious hemorrhage may occur if the artery is accidentally wounded. With the hernia reduced, the sac may be dissected out, ligated and excised. Sträter suggested closing the obturator canal with a flap one-half inch (1.25 cm.) wide, and about 3 inches (7.5 cm.) long, taken from the inner side of the pectineus muscle. It is drawn through the canal by an aneurysm needle or a heavy suture, and the wound closed. This method has been successfully used by Kindl.

Combined Operation.—Occasionally, when the obturator operation is undertaken, it is also necessary to open the abdomen from above, either to treat strangulated intestine, control hemorrhage, or to close the internal opening. Corner and Huggins have reported a case where the internal opening could not be closed through the obturator incision, and it was necessary to perform a laparotomy and invert the sac by pushing it up from the outside. Jaboulay and Patel reported two instances in which the obturator operation was done, and in both the intestine was so tightly constricted that it was necessary to open the abdomen from above to relieve the strangulation. Albertin encountered a Richter's hernia which could not be reduced through the obturator incision, so he prolonged the thigh incision upward and opened the abdomen above Poupart's ligament.

Radical Cure.—In the last few years, owing to improved methods in diagnosis, nonstrangulated obturator hernia is being more frequently recognized and treated by radical operation.

Inguinal Route for Obturator Hernia.—The inguinal route for obturator hernia has recently been used with success by Milligan and by Kindscherf. Milligan made an oblique incision parallel to Poupart's ligament and just above the inner end of it, exposing the external abdominal ring and the attachment of the external oblique aponeurosis to Poupart's ligament. The aponeurosis was incised in the line of the skin incision, and the upper part retracted. The spermatic cord was drawn upwards out of the way, the external iliac vein located and the femoral ring defined. The peritoneum was retracted upwards from the pubic bone and the obturator foramen could be seen and felt about one inch (2.5 cm.) behind the femoral ring; the obturator nerve could be plainly seen. The hernia was nonstrangulated and had reduced itself spontaneously; the sac was easily inverted and obliterated by suturing. Kindscherf concluded that this method of approach is especially adapted to a nonstrangulated hernia, but he does not recommend it for the strangulated variety because it does not provide enough room to deal expeditiously with a gangrenous intestine.

Bibliography

OBTURATOR HERNIA

- ALBERTIN: Hernie obturatrice étranglée; intervention par double voie crurale et abdominale; guérison. *Prov. méd.*, Lyon, 1898, xii, 124.
- ARNAUD, DE RONSIL: See de Garengéot, R. J. C.: p. 711.
- ARNAUD, G.: See de Garengéot, R. J. C.: p. 715.
- AUERBACH, S.: Beitrag zur Lehre von der Hernia obturatoria. *München med. Wehnschr.*, 1890, xxxvii, 737-738; 754-757; 774-776.
- BARY: See Wood, A. C.: Appendicular femoral hernia, with notes of one hundred cases. *Ann. Surg., Phila.*, 1906, xliii, 668-703.
- BÉRARD, L.: De la hernie obturatrice étranglée. *Bull. méd. Par.*, 1898, xii, 261-263.
- BERGER, P.: Hernie obturatrice. In: *Traité de Chirurgie*. Duplay, S., et Reclus, P., Paris, Masson, 1892, vi, 810-824.
- BORCK: Ein Fall von Hernia obturatoria. *Arch. f. klin. Chir.*, Berl., 1893, xlii, 369-372.
- BOURGEAUD: See Jaboulay, M. et Patel, M.: p. 363.
- CAMPER, P.: Demonstratum anatomico-pathologicarum. *Amstelædami*, Schreuder, J. & Mortier, P., 1762, ii, 17.
- CASSEBOHM: See Günz, J. G.: p. 79.
- COOPER, A. P.: The anatomy and surgical treatment of abdominal hernia. In two parts. 2nd ed. by C. A. Key, Lond., Longman, Reese, Orme, Brown & Green, 1827.
- CORNER, E. M., AND HUGGINS, M.: The repeated strangulation of an obturator hernia necessitating its radical cure, with remarks upon obturator herniae in general. *Proc. Roy. Soc. Med., Lond.*, 1908-9, ii, surg. sect., 137-148.
- COULSON, W.: On a case of obturator hernia. *Lancet*, Lond., 1863, ii, 303-304.
- DUPUYTREN, G.: See Pimbet, D.: p. 13.
- DUVERNEY, J. G.: See de Garengéot, R. J. C.: p. 711; 714.
- ECCLES, W. M.: Discussion: *Proc. Roy. Soc. Med., surg. sec.*, Lond. 1908-09, ii, 146-147.
- ELDER, J. M.: Report of a case of strangulated obturator hernia. *Ann. Surg., Phila.*, 1900, xxxii, 285-288.
- ENGLISCH, J.: Ueber Hernia obturatoria. *Leipz. & Wien*, F. Deuticke, 1891.
- FREDET, P.: Remarques a propos d'une pièce de hernie obturatrice. *Rev. de chir., Par.*, 1901, xxiii, 112-124.
- DE GARENGÉOT, R. J. C.: Sur plusieurs hernies singulieres. *Mém. Acad. roy. de chir., Par.*, 1743, i, 699-716.
- GERDES: Ein Fall von Hernia obturatoria incarcerata. *Deutsche med. Wehnschr., Leipz.*, 1895, xxi, 83.
- GLADSTONE, R. J.: Obturator hernia of the bladder and of the fallopian tube. *Ann. Surg., Phila.*, 1901, xxxiv, 796-807.
- GODLEE, R. J.: On a case of obturator hernia. *Lancet*, Lond., 1885, i, 655.
- GRASER, E.: Hernia. In: *A system of practical surgery*. Bergmann, Bruns, Mikulicz. English transl. ed. by W. T. Bull, New York and Phila., Lea Bros. & Co., 1904, iv, 606-610.
- GÜNZ, J. G.: Observationum anatomico-chirurgicarum de herniis libellus. *Lipsiæ*, J. C. Langenhemium, 1744.
- HOENEL: See Macready, J. F. C. H.: p. 277.
- HILTON, J.: Obturator hernia simulating intestinal obstruction within the abdomen, to relieve which gastrotomy was performed. *Med. Chir. Tr.*, Lond., 1848, xxxi, 323-335.
- HOWSHIP, J.: Practical remarks on the discrimination and appearances of surgical disease. *London*, Churchill, 1840, p. 301; 323-324.
- JABOULAY, M., AND PATEL, M.: Hernies. XXV *Nouveau traité de chirurgie*. Le Dentu, A., et Delbet, P. Paris, Baillière, 1908, p. 355-365.
- KINDL, J.: Hernia obturatoria. *Prag. med. Wehnschr.*, 1912, xxxvii, 214-215.
- KINDSCHERF, J.: Die retrograde herniotomie. *Deutsche Ztschr. f. Chir.*, Leipz., 1919, cxlviii, 276-280.
- KRÖNLEIN, R. U.: Ueber die Bedeutung des Howship-Romberg'schen Symptomenkomplexes bei der Hernia obturatoria incarcerata. *Beitr. z. klin. Chir.*, Tübing, 1890, vi, 195-209.
- LANDERER, A.: Beitrag zur differentiellen Diagnose der Hernia obturatoria. *Festschr.*, Benno Schmidt, Leipz., 1896, p. 190-192.
- LEJARS, F.: Urgent surgery. English transl. from the 6th French ed. by W. S. Dickie. *New York*, W. Wood & Co., 1910, ii, 251-256.
- LILLOTTE, W. J.: Ein Fall von Hernia obturatoria. *I. D.*, Bonn, 1905.
- LEMAIRE: See Macready, J. F. C. H.: p. 277.

- MACREADY, J. F. C. H.: A treatise on ruptures. Lond., C. Griffin & Co., 1893.
- McMAHON, C. G.: Obturator hernia with report of case. *Ann. Surg., Phila.*, 1915, lxii, 710-715.
- MARSHALL, H. W.: A case of associated pains in the knee and penis. *Boston M. & S. J.*, 1919, clxxxi, 367-368.
- MASON, J.: A case of strangulated obturator hernia; recovery. *St. Barth. Hosp. Rep.*, Lond., 1891, xxvii, 65-70.
- MEER, A.: Ueber wiederholte Einklemmung im Foramen obturatorium sin. (Darmwandhernie) combinirt mit Volvulus ilei. *Deutsche Ztschr. f. Chir.*, Leipz., 1901, lx, 583-587.
- MEYER, E.: Ueber Hernia obturatoria. *Arch. f. klin. Chir.*, Berl., 1913-1914, ciii, 497-535.
- MILLIGAN, E. T. C.: The inguinal route for radical cure of obturator hernia. *Brit. M. J.*, Lond., 1919, ii, 134-135.
- OLIVARES, D. J. G.: Extirpation d'une tumeur énorme compliquée d'une hernie ovale et d'une hernie sciatique. *J. de chir. (Malgaigne)*, Par., 1845, iii, 340-342.
- PICQUE, L., AND POIRIER, P.: Étude sur la hernie obturatrice. *Rev. de chir.*, Par., 1891, xi, 956-1005.
- PIMBET, D.: De la hernie obturatrice. Thèse, Paris, 1882.
- RAWLES, B. W.: Obturator hernia; case report. *Virginia M. Month.*, Richmond, 1918, xxiii, 51.
- RISCHBIETH, H.: A case of multiple herniæ, obturator, ischiatic and femoral in an adult. *Australas. M. Gaz.*, Sydney, 1913, xxxiv, 71-74.
- ROCHET: Hernie obturatrice, phlegmon stereoral de la cuisse; mort. *Clinique*, Brux., 1891, v, 177-179.
- ROMBERG: Operatio herniæ foramainis ovalis incarceratæ. In: J. F. Dieffenbach, *Operative Chirurgie*, Leipz., F. A. Brockhans, 1845, ii, 619-626.
- ROSE, E.: Ein Bauchhohlenschnitt bei latenter Einklemmung einer Hernia obturatoria interstitialis. *Deutsche Ztschr. f. Chir.*, Leipz., 1893, xxxv, 1.
- SCHMIDT, B.: Verwachsene Hernia obturatoria und Operation an ihr. *Arch. d. Heilk.*, Leipz., 1865, p. 468-470.
- SCHWARZSCHILD, M.: Osteoplastischer Verschluss einer Hernia obturatoria nach dreimaliger Einklemmung im Foramen obturatorium sinistrum. *Deutsche Ztschr. f. Chir.*, Leipz., 1904, lxxiv, 418-426.
- STONES, G. F.: Strangulated obturator hernia. *Brit. M. J.*, Lond., 1917, ii, 861.
- STRÄTER, M.: Die Radikaloperation der Hernia obturatoria. *Zentralbl. f. Chir.*, Leipz., 1905, xxxii, 1117-1118.
- THIELE, G.: Die Hernien des eirunden Loches. I. D., Berlin, 1868.
- TONKING, J. H.: Obturator hernia following muscular effort. *Lancet*, Lond., 1904, ii, 917-918.
- TRÉLAT, E.: Hernie obturatrice. Kelotomie. *Bull. Soc. de chir. de Par.*, 1872, xxiii, 525-534.
- VAN ZWALENBURG, C.: Report of the radical operative cure of a double obturator hernia. *Surg. Gynec. & Obst.*, Chi., 1913, xvi, 422-424.
- VAN ZWALENBURG, C.: Final report on a case of radical operation for cure of double obturator hernia; failure. *Surg. Gynec. & Obst.*, Chicago, 1921, xxxiii, 429-430.
- VINSON, P. A.: De la hernie sous-pubienne. Thèse, Paris, 1844.

CHAPTER XXI

SCIATIC HERNIA

Synonyms.—Sciatic hernia; Ischiatic hernia; Gluteal hernia; Hernia incisurae ischiadicae; Ischiocèle.

Definition.—A sciatic hernia is one that makes its exit through the greater or lesser sacrosciatic foramen. It is the rarest of all hernias; in 1923 I was able to collect only 30 cases from the literature.

Historical

Sciatic hernia was probably first observed by Verdier, in 1753. In 1778 Haller described a sciatic hernia containing a portion of the bladder, and in 1759, in the course of a dissection of a female, Camper found a sciatic hernia which contained an ovary. Schreger, in 1818, observed two cases of congenital sciatic hernia. In one case the tumor was rounded and elastic; following strangulation, it had ulcerated and a fecal fistula had formed. In the second case, there was a round tumor with a pedicle; the hernia was irreducible, and was operated on by mistake for a cyst, and the patient died. Meinel, in 1849, saw a mass the size of a fist on the right buttock of a new born infant. He opened the tumor, which was cystic, and it also contained a loop of intestine; the child died. Knüppel, in the same year, saw a sciatic hernia in a man, aged 33 years; it was soft and reducible, and descended to the middle of the thigh. Chénieux, in 1890, reported a sciatic hernia of the ovary, and about the same time, Schillbach observed the case of a woman who died from strangulation of sciatic hernia; at autopsy, intestine and ovary were found in the sac. Crosslé, in 1873, saw a sciatic hernia which was caused by a strain. Important papers on this subject have been written by Wassilieff, Schwab, Garré, Boccard, Hochenegg, Casott, Martel, Eiselsberg, and Köppl.

Age.—In 28 of the 30 cases I collected from the literature the ages of the patients were as follows:

Under 1 year	4
1 to 10 years	1
11 to 20 years	0
21 to 30 years	6
31 to 40 years	6
41 to 50 years	6
51 to 60 years	2
61 to 70 years	0
71 to 80 years	1
Child	1
Adult	1

Sex and Site.—In 27 cases the sex of the patient and the site of the hernia was given as follows:

MALE		FEMALE			RIGHT SIDE SEX NOT GIVEN
R.	L.	R.	L.	SIDE NOT GIVEN	
6	6	6	5	3	1

Anatomy

1. Course of Sciatic Hernia.—A sciatic hernia may escape through the greater sacrosciatic foramen, or through the lesser sacrosciatic foramen. It makes its exit most frequently through the greater sacrosciatic foramen, above the pyriformis muscle. Before the hernia enters the sacrosciatic foramen its position is in the pelvis, in front of the pyriformis muscle and sciatic nerve. After passing through the sacrosciatic foramen, it crosses over the nerve and lies behind it, and is covered by the gluteus maximus muscle and fascia. As the hernia enlarges, it passes into the thigh at the lower border of the gluteus maximus muscle, or it may pass forward toward the groin, above the trochanter.

The course of sciatic hernia is toward the buttock and thigh, and it is confined to the side where it makes its appearance. It cannot extend upward, because of the attachment of the gluteus maximus muscle to the ilium and the lumbar fascia; and it cannot extend forward, on account of the gluteus medius and gluteus minimus. The gluteus medius arises from the ilium and from the heavy fascia of the gluteal aponeurosis; the gluteus minimus also arises from the ilium, and both muscles terminate in tendons which are inserted in the great trochanter. The hernia is prevented from extending backward and inward by the absence of subcutaneous tissue, and the mass of muscle fibers, which have their insertion in the region of the coccyx and anus. The natural course of sciatic hernia, therefore, is downward, with the sciatic nerve. This is the path of least resistance because there is an abundance of loose areolar tissue in the thigh which offers only slight restraint. The hernia sometimes forms a hard mass beneath the muscles in the middle of the thigh, and in rare instances it may reach the leg. The tumor may be as small as a pigeon's egg or as large as a man's head. (Fig. 195.)

The sacrosciatic ligaments divide the sciatic notch into two foramina, the greater and the lesser. The greater sacrosciatic foramen is bounded above and in front by the posterior border of the os innominatum; behind, by the great sacrosciatic ligament; and below, by the lesser sacrosciatic ligament. The lesser sacrosciatic foramen is bounded in front, by the tuberosity of the ischium; above, by the spine and lesser sacrosciatic ligament; and behind, by the greater sacrosciatic ligament. The greater sacrosciatic foramen is divided into two parts by the pyriformis muscle which passes through it. Above this muscle, the gluteal vessels and superior gluteal nerve leave the

pelvis; below it, the sciatic artery, vein and nerve, the internal pudic vessels and nerve, the inferior gluteal nerve, and the nerves to the obturator internus and quadratus femoris muscles.

2. **Varieties of Sciatic Hernia.**—Sciatic hernia is most conveniently divided into three varieties: the suprapyramidal, which appears through the



Fig. 195.—Course of sciatic hernia. The hernia usually passes downward into the loose areolar tissue of the thigh. It may attain the size of a man's head.

great sacrosciatic foramen above the pyriformis muscle; the subpyramidal, which also comes through the great sacrosciatic foramen, but is below the pyriformis muscle; and the subspinous, which makes its exit through the lesser sacrosciatic foramen, below the spine of the ischium. In strangulation the point of constriction is at the opening between the bone and the sacrosciatic ligaments:

a. *The Suprapyramidal Hernia.*—The suprapyramidal hernia lies to the outer side of the gluteal artery and is bounded above, by the posterior border of the os innominatum, and below and externally, by the pyriformis muscle.

b. *The Subpyramidal Hernia.*—The subpyramidal hernia lies on the inner side of the sciatic nerve and artery, and the internal pudic vessels. It is bounded above, by the pyriformis muscle, and below, by the superior border of the greater sacrosciatic ligament.

c. *The Subspinous Hernia.*—The subspinous hernia is bounded above, by the spine and lesser sacrosciatic ligament; behind, by the greater sacrosciatic ligament; below and externally, by the bony arch, which is covered by the tendon of the obturator internus muscle. The internal pudic vessels and nerve lie to the outer side of the hernial sac.

3. **Frequency of the Varieties.**—Of the 30 cases I collected from the literature 12 were suprapyramidal, 7 subpyramidal, and 1 subspinous. (In the remaining cases, the variety was not mentioned.)

4. **Contents of the Sac.**—The most frequent content of the sac is small intestine; sometimes omentum or large intestine, ovary, tube, and bladder are found. In the cases I collected the contents of the sac were given in 18 as follows:

Small intestine	9
Small intestine and bladder	1
Bladder	1
Ovary	2
Ovary and tube	2
Sigmoid	2
Colon	1

Etiology

1. **Predisposing causes.**—In 1811 Monro suggested that sciatic hernia might be due to a congenital defect. Of the 30 cases I collected, six patients were born with sciatic hernia.

Sex.—Sciatic hernia occurs with nearly equal frequency in the two sexes. In women it has usually been found in those who have had one or more pregnancies.

Age.—The oldest patient on record was 72. Most of the men were between 30 and 40, while a majority of the women were past 40.

Other Predisposing Causes.—Traction due to tumors in the gluteal region, relaxation of muscles, constipation, strain and laborious occupations are predisposing causes of sciatic hernia.

2. **Accidental Causes.**—The most frequent accidental causes of sciatic hernia are direct and indirect injury. Any operation in the gluteal or sacral regions may be followed by postoperative hernia.

Symptoms and Diagnosis

1. **Reducible Sciatic Hernia.**—The symptoms of small sciatic hernia are always obscure unless there is a tumor. There may be only a slight swelling in the gluteal region with a tender point over the sacrosciatic foramina. Sometimes there is pain radiating down the sciatic nerve. In Wassilieff's case, the pain radiated to the upper part of the thigh. In Perry's case, the pain was referred down into the right leg. Martel reported a case of sciatic hernia that caused the patient to lose the use of the lower limb; the condition persisted for 5 months, being relieved only when the hernia was operated on and the pressure removed from the sciatic nerve.

If the hernia is large, there will be a soft round tumor which is more or less reducible, and gives an impulse when the patient coughs or strains in any way. If the sac contains intestine, a gurgling sound can be heard as the

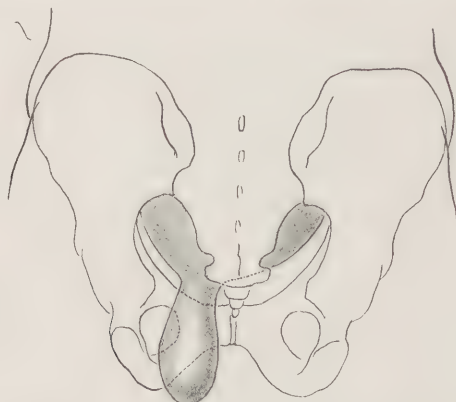


Fig. 196.—Roentgen-ray picture of sciatic hernia of a diverticulum of the sigmoid (Courtesy of Dr. Marchetti).

hernia is reduced. Subjective symptoms are indefinite. Occasionally these patients complain of colicky pain, and some have been more comfortable when lying down. In a majority of cases, the diagnosis is not made until strangulation occurs. Roentgen-ray examination should not be neglected. In Marchetti's case, the shadow of the hernia was clear and enabled the author to confirm his tentative diagnosis. (Fig. 196.)

2. **Strangulated Sciatic Hernia.**—The diagnosis of strangulated sciatic hernia is usually made during the course of a laparotomy for intestinal obstruction. If, in addition to the symptoms of intestinal strangulation, there is a tense irreducible tumor in the gluteal region, strangulated sciatic hernia should be suspected. In searching for a tender point where there is no tumor, the sacrosciatic notch can be located by placing the patient in a recumbent posture and drawing a line from the posterior superior spine of the ilium to the upper surface of the great trochanter. The sacrosciatic notch, which is

crossed by this line, is just below the junction of the middle and upper third of the line.

In most of the cases reported, only a small loop of intestine has been strangulated. Rarely a part of the intestinal wall has been caught in the constriction (partial enterocoele), as in the case reported by Perry, where the symptoms, constipation, colicky pain, nausea, vomiting, and some distention of the abdomen, pointed to complete strangulation.

Differential Diagnosis

Sciatic hernia sometimes occurs with hernia in other regions. Olivares saw a patient with sciatic and obturator hernia, and Rischbieth saw one who had sciatic, obturator, and femoral hernia.

Myromas and Lipomas.—These tumors are of slow growth and are not reducible. They do not give an impulse on coughing unless complicated by hernia.

Abscess.—Abscess, especially when it follows hip joint disease, may form a tumor on the posterior surface of the thigh, but the history of the course of the disease and the absence of the characteristic signs of sciatic hernia, make diagnosis possible.

Perineal Hernia.—Perineal hernia is distinguished from sciatic hernia by its location above the greater sacrosciatic ligament.

Other Diseases.—Sciatic hernia may sometimes be mistaken for the following conditions: Fibroma, echinococcus cyst, malignant growth, aneurysm, spina bifida, and gluteal abscess.

Prognosis

Because of the difficulty in diagnosing sciatic hernia, the prognosis is grave. A majority of the cases on record were not diagnosed until after strangulation had occurred. On account of the danger of strangulation, operation should always be undertaken as soon as the diagnosis is made.

Of the 30 cases I collected from the literature, 10 patients were treated by operation; 8 recovered and 2 died. Nine patients had reducible hernias and were treated with a bandage. Seven cases were found at autopsy; death was due in 4 of these to strangulation.

Treatment

Radical operation, preferably through an abdominal incision is the treatment of choice for sciatic hernia. The advantages of laparotomy over the sciatic operation are: Less danger of hemorrhage; the operation can be carried out more rapidly; the sac can be ligated higher; the opening can be closed more securely; and if strangulation is present, it can be taken care of without the necessity of making a second incision, as is required when the sciatic operation is employed.

1. **Mechanical Treatment.**—The truss or bandage treatment of sciatic hernia is unsatisfactory, because of the difficulty of fitting a support to this region, and the constant danger of strangulation.

2. **Strangulated Hernia.**—Taxis is not to be recommended, although it may rarely succeed as in the case reported by Wassilieff.

There are two routes for operating on sciatic hernia, the abdominal and the sciatic:

a. *Abdominal Operation.*—The patient is placed in the Trendelenburg position and the abdomen opened by a median incision below the umbilicus. In the female, the sciatic opening is found behind the broad ligament. (Fig. 197.) The loops of distended and collapsed intestine are followed down to the sciatic

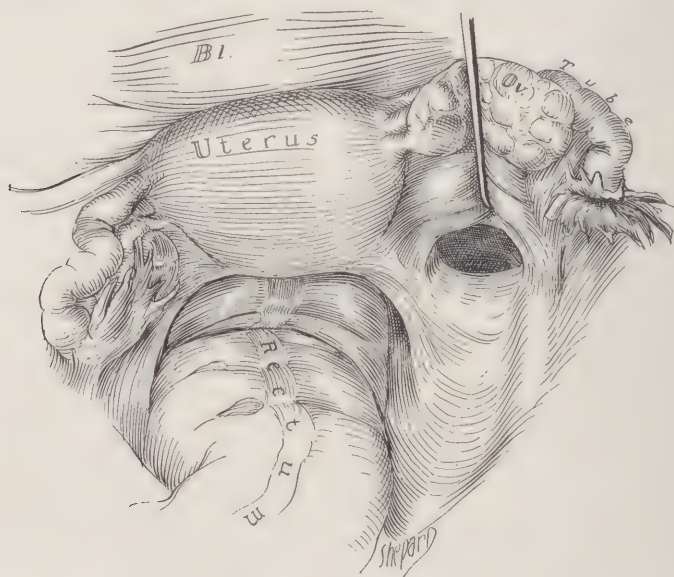


Fig. 197.—Anatomy of sciatic hernia. In the female the sciatic opening is found behind the broad ligament.

opening and very gentle traction is made to reduce the strangulation, while an assistant makes firm counter-pressure over the gluteal region. If this does not succeed, the opening should be stretched downward and outward by means of a finger, a grooved director, or by inserting a closed clamp and carefully separating the blades. If the constriction cannot be stretched sufficiently to permit reduction of the hernia, a free exposure of the ring should be secured, the artery and nerve located, and the constriction cautiously incised downward and outward. If the intestine is viable, it is returned to the abdomen; if only a small area is gangrenous, it may be inverted by Lembert sutures. If a resection is necessary, a lateral or an end-to-end anastomosis can be done, or a Murphy button employed and the whole covered over by a flap of omentum.

If the sac is small, it may be seized at the bottom with a clamp, inverted and tied off. The sac may be folded upon itself, sutured, and used as a pad to close the opening, or the opening can be closed over with fascia or a flap from the piriformis muscle. (Figs. 198 and 199.) Perry reported a case of strangulated sciatic hernia in a woman 18 weeks' pregnant. The abdomen was opened by midline incision, and a Richter's hernia was found in the sciatic opening. The intestine was torn in freeing it from the constriction,

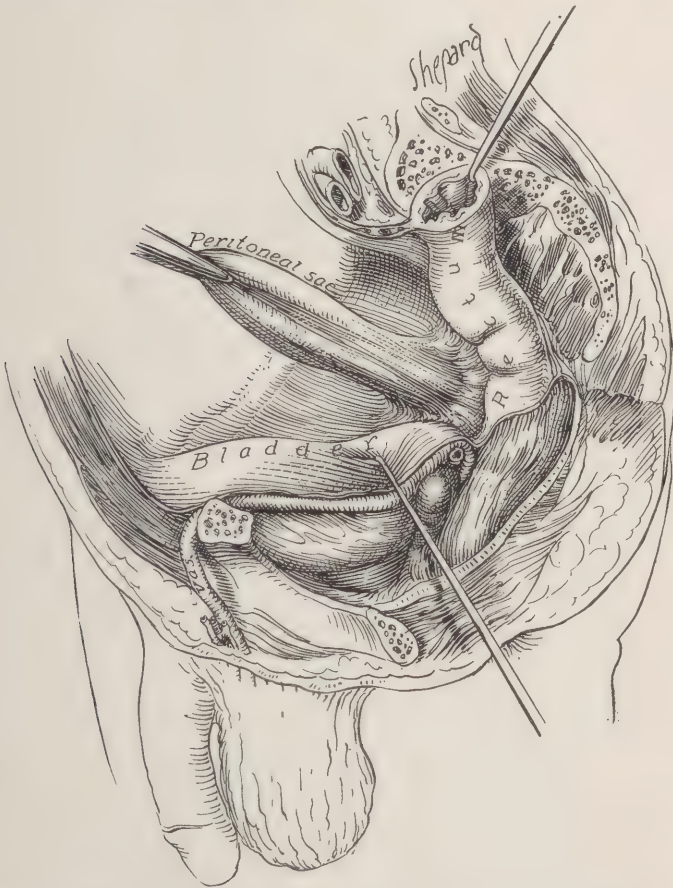


Fig. 198.—Abdominal operation for sciatic hernia. The constriction is relieved, the hernial contents reduced and dealt with, and the sac inverted. The sac may be folded on itself, sutured and used as a pad to close the opening.

and an end-to-end anastomosis was done. The sciatic opening was above the piriformis on the right side and admitted the tips of two fingers for a distance of $\frac{1}{2}$ inch (1.25 cm.). The pregnancy was undisturbed and went to term.

b. *The Sciatic Operation.*—The incision, which is 4 to 5 inches (10 to 12.5 cm.) long, is made over the center of the tumor on a line drawn from the posterior inferior spine of the ilium to the middle of the posterior border of the

great trochanter. The gluteus maximus muscle is incised and the edges retracted to give a wide exposure, so that each layer of tissue may be clearly seen before dividing it, thus avoiding serious hemorrhage from the gluteal artery and injury to the sciatic nerve. The sac is beneath the gluteus maximus muscle,

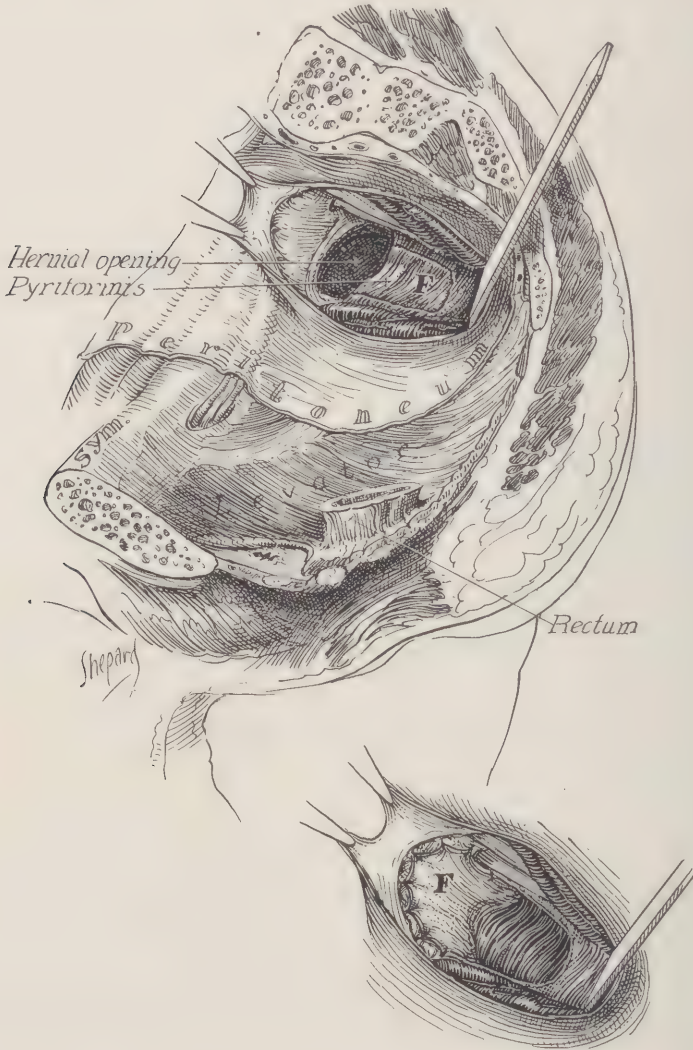


Fig. 199.—Abdominal operation for sciatic hernia. The sac has been excised and a flap of fascia turned up from the pyriformis muscle, and tacked over the opening by interrupted sutures.

and if it is of the suprapyramidal type, which is most frequent, the sciatic notch will be above the neck of the sac, and the pyriformis muscle will be below it. The gluteal artery is usually above. The sac should always be opened and the contents inspected before any attempt to reduce the hernia

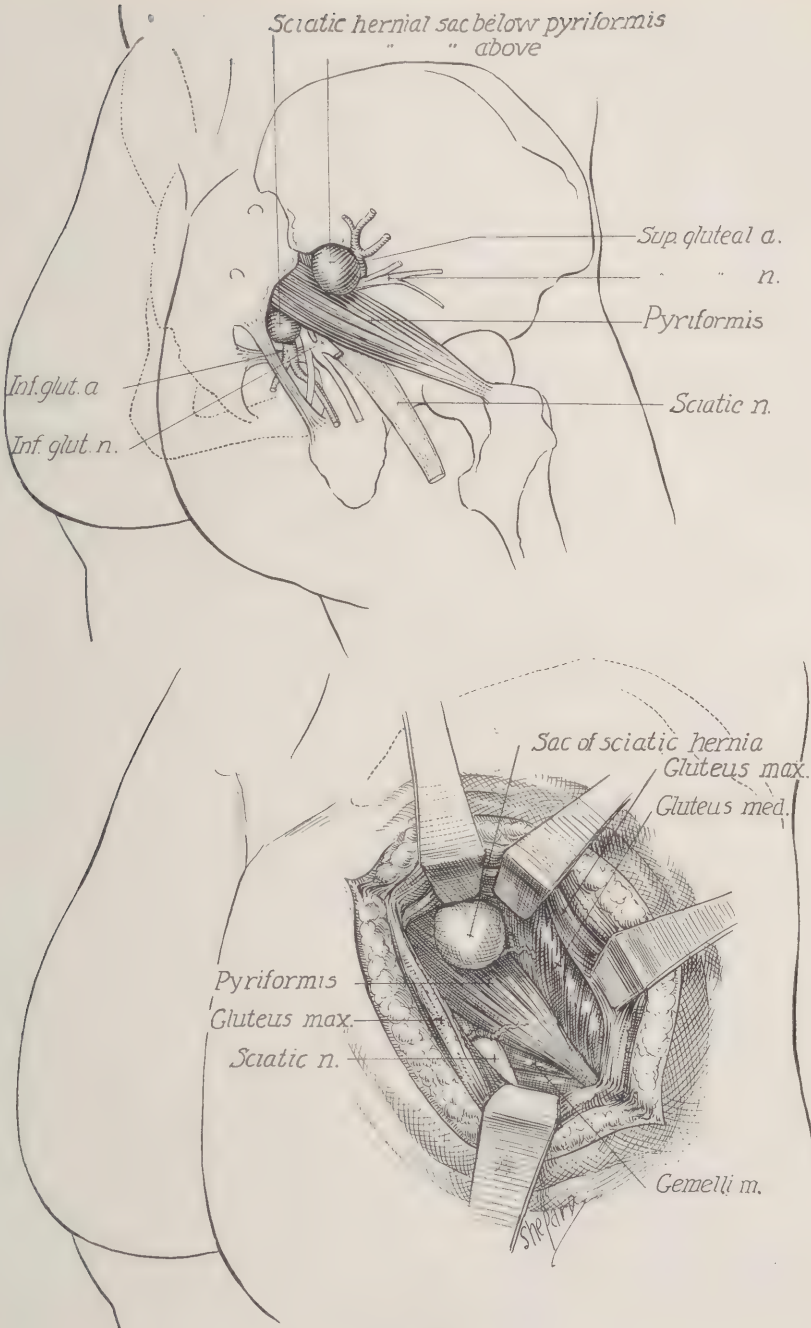


Fig. 200.

Fig. 201.

The anatomy of sciatic hernia.

Fig. 200.—Suprapyramidal hernia. This variety of hernia passes the greater sciatic notch above the pyriformis muscle and emerges through the same notch below the pyriformis.

Fig. 201.—Operation by the sciatic route. The incision is made over the center of the tumor, the gluteus maximus muscle incised, and the edges retracted to expose the sac. If the hernia is of the suprapyramidal type, the sciatic notch will be above the neck of the sac and the pyriformis muscle below.

is made. The constriction should be relieved by stretching it downward and outward, either by means of the finger, a grooved director, or by inserting a clamp and cautiously spreading its blades. If it is necessary to incise the constricting ring, several shallow notches can be made, followed by digital dilatation. The constriction should be divided below, in suprapyramidal hernia; and at the inner side, in the subpyramidal and subspinous varieties.

If the intestine is viable it is returned to the abdominal cavity. If the gangrenous area is small, it can be turned in, and the edges of the normal intestine sutured over it and reenforced with a flap of omentum. If gangrene involves the whole loop it should be dealt with through an abdominal incision.

The sac is ligated and excised or used along with a flap from the pyramiformis muscle, to close the opening. (Figs. 200 and 201.) The objections to the sciatic operation are: The depth of the wound; the danger of hemorrhage from the gluteal artery; the possibility of injury to the sciatic nerve; the chance of encountering strangulated intestine; and the difficulty of closing the hernial opening.

c. *Combined Operation.*—In certain instances, it may be advisable to use both the sciatic and abdominal routes. The sciatic operation may be required to aid in the reduction of the hernia and to permit the complete removal of a large sac, while the abdominal operation is necessary when extensive gangrene or other complications are present.

d. *Radical Operation in Nonstrangulated Hernia.*—Nonstrangulated sciatic hernia and openings in the sacrosiatic foramina discovered in the course of other abdominal operations, should always be closed by muscle or fascia flaps, on account of the danger of a strangulated hernia occurring later.

Bibliography

SCIATIC HERNIA

- BOCCARD, F.: Étude sur les hernies du plancher du bassin. Thèse, Lyon, 1895.
- CAMPER, P.: Demonstrationum anatomico-pathologicarum. Amstelædami, J. Schreuder et P. Mortier, 1762, ii, 17.
- CASOTT: Ein Fall von eingeklemmter Hernia ischiadica. Deutsche med. Wehnscr., Leipz., 1900, xxvi, 357.
- CHÉNIEUX, F.: Tumeur volumineuse de la région fessière droite. Hernie de l'ovaire. Ablation. Guérison. Bull. et mém. Soc. de chir. de Par., 1890, xvi, 396.
- CROSSLÉ, F. C.: Ischiatic hernia. Proc. Path. Soc., Dublin, 1871-3, n.s., v, 188-192.
- EISELSBERG, F.: Abgeschnürter Darm als Inhalt einer Hernia ischiadica. Arch. f. klin. Chir., Berl., 1905, lxxvi, 518-524.
- GARRÉ, C.: Die Hernia ischiadica. Beitr. z. klin. Chir.; Tübing., 1892, ix, 198-208.
- HALLER, A.: Elementa physiologiæ corporis humani. Bernæ, Societatis typographiæ, 1765, p. 305.
- HOCHENEGG, J.: Ueber sacrale Hernien. Wien. klin. Wehnscr., 1896, ix, 1094-1099.
- KNÜPPEL: Hernia ischiadica. Med. Ztg., Berl., 1849, xix, 241.
- KÖPPL, E.: Beiträge zur Kenntnis und Kasuistik der Hernia ischiadica an der Hand des ersten radikal operierten und geheilten Falles. Beitr. z. klin. Chir., Tübing., 1908, lviii, 314-352.
- MARCHETTI, G.: Sopra un caso di ernia ischiatica contenente un ampio diverticolo sigmoideo formatasi da causa mai ancora notata. Policlin., Roma, 1919, xxvi, sez. chir., 244-248.

- MARTEL, L.: Pointe de hernie ischiatique; impotence fonctionnelle du membre inférieur pendant 5 mois; opération; guérison. Loire méd., St.-Étienne, 1900, xix, 165-174.
- MEINEL, A. E.: Ein Fall von Hernia ischiadica nebst einigen Bemerkungen über diesen Vorfall. Vrtljschr. f. d. prakt. Heilk., Prague, 1849, xxiii, 116-129.
- MONRO, A.: The morbid anatomy of the human gullet, stomach and intestines. Edinburgh, Constable & Co., 1811, p. 379-380.
- OLIVARES, D. J. G.: Extirpation d'une tumeur énorme compliquée d'une hernie ovulaire et d'une hernie sciatique. J. de chir. (Malgaigne), Par., 1845, iii, 340-342.
- PERRY, A. C.: Strangulated sciatic hernia with pregnancy. Lancet, Lond., 1920, i, 318.
- RISCHBIETH, H.: A case of multiple herniae, obturator, ischiatic and femoral, in an adult. Australas. M. Gaz., Sydney, 1913, xxxiv, 71-74.
- SCHILLBACH: Hernia ischiadica ovarii dextri incarcerata. Jenaische Ztschr. f. Med. u. Naturw. Leipz., 1864, i, 242-244.
- SCHREGER, B. N. G.: Chirurgische Versuche. Nürnberg, J. L. Schrag, 1818, ii, 167-179.
- SCHWAB, A.: Sur la hernie ischiatique. Arch. gén. de méd., Par., 1892, ii, 34-58.
- VERDIER, C.: Recherches sur la hernie de la vessie. Mém. Acad. roy. de chir., Par., 1753, ii, 1-58.
- WASSILIEFF, A.: Sur la hernie ischiatique. Rev. de chir., Par., 1891, xi, 199-215.

CHAPTER XXII

PERINEAL HERNIA

Synonyms.—Ischio-rectal hernia (Lacoste); Pudendal hernia (Cooper); Posterior labial hernia (Seiler); Subpubic hernia (Winckel); Hernia of Douglas' pouch (Berger); Hernia through the outlet of the pelvis (Macready); Hernia through the pelvic floor (Boccard); Levator hernia (Blake and Chase); Vaginal hernia; Labio-vaginal hernia.

Definition.—Perineal hernia is a protrusion of abdominal viscera through the muscles and fascia of the outlet of the pelvis.

I believe the term "pudendal hernia" should be restricted to designate those inguinal hernias that descend into the labium majus, and the term "perineal" applied to those that come through the outlet of the pelvis. Perineal hernia is rare, and usually occurs in women. Macready, in 1893, was able to collect only 40 cases from the literature, and of these, 6 were in men.

Historical

The first case of perineal hernia was observed by Méry in 1713—a perineal hernia of the bladder that was the size of an egg, and reducible. Soon after Méry's report, Curade saw a pregnant uterus together with part of the bladder in a perineal hernia. Smellie, in 1731, described perineal hernia in women. Some writers believe that Méry's, Curade's, and Smellie's cases were subpubic hernias, and not true perineal hernias.

Papen's case of perineal hernia observed in 1750, is undoubtedly a true perineal hernia, and it has been erroneously included by some writers with the first cases of sciatic hernia. Papen wrote that there was an oval opening on the right side of the anus and coccyx, which was bounded by the sacrosciatic ligament, the ischium and the pubic bone. In 1740 Chardenon observed the first case of perineal hernia in a man; and in 1760 Pipelet reported the second case. Verdier's monograph on hernia of the bladder appeared in 1753.

Richter, in 1785, advanced the theory that these hernias are due to an abnormal opening in the levator ani between the rectum and the bladder. Sabatier agreed with this opinion, but it was denied by Chopart and Desault. Important papers were written by Scarpa in 1821, and Cooper in 1828. Following these, papers appeared by Lawrence, Hager, Jacobson, Boccard, Walther, and Wolff. Ebner's monograph published in 1887 was an important contribution to the anatomy and etiology of this subject. Later papers have appeared by Barrett, Harrington, Violet, Mosecowitz, Sweetser, Anspach, Grattan, and Chase.

Anatomy

Boundaries of the Pelvic Outlet.—The pelvic outlet is bounded in front by the subpubic ligament and the rami of the os pubis and ischium; behind, by

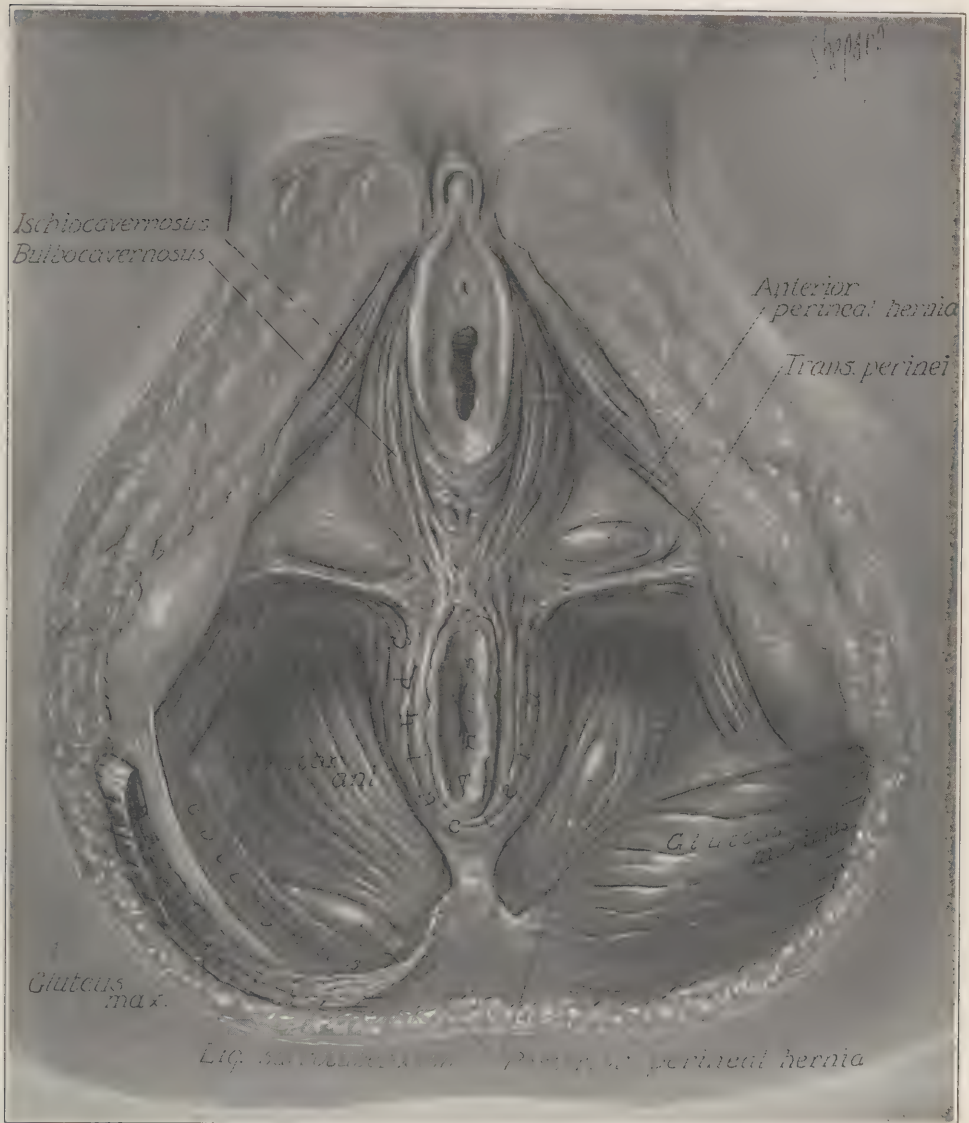


Fig. 202.—The anatomy of perineal hernia in the female. Showing the points of exit of perineal hernias.

the great sacrospinous ligaments and the tip of the coccyx; and externally, by the tuberosities of the ischia; the rectum, urethra and vagina pass through this outlet. The floor of this space is formed by the levator ani and coccygeus

muscles. The inner surface of the levator ani is separated from the viscera of the pelvis and from the peritoneum by the recto-vesical fascia, and the outer or perineal surface of the muscle forms the inner boundary of the ischio-rectal fossa. The inner surface of the coccygeus muscle is covered by the rectum. There is a cellular interspace between the posterior free border of the levator ani and the lower border of the coccygeus; this space is the weak point in the perineum, and it is through this gap that most hernias appear. (Fig. 202.)

Elbner, in 60 dissections on the cadaver, found an interstices 47 times between the levator ani and the ischio-coccygeus muscles; and an interspace between the coccyx and the ischio-coccygeus muscle, 21 times. Scarpa had previously called attention to interstices in the levator ani muscle.

Douglas' Pouch or Culdesac.—The recto-vaginal culdesac was first described by James Douglas, early in the 18th century. The position of the pouch varies, being dependent upon the age and sex of the patient, and fullness of the bladder and rectum. The presence of this culdesac is one of the principal factors in explaining the occurrence of perineal hernia.

In embryonic life this pouch forms a long canal descending to the perineum. It does not always retrogress, but may persist partially or completely when it forms a true hernial sac, analogous to the peritoneal canal of congenital inguinal hernia (Rochard). The position of the culdesac is higher in males than in females. The pouch is elongated from 3 to 3½ inches (7 to 8 cm.) when the bladder is full, and to 4 inches (10 cm.) when the rectum is distended.

Hernias of the pelvic outlet are divided into two varieties by the transversus perinei muscle, the anterior perineal and the posterior perineal. The occurrence of anterior perineal hernia in men is denied by some writers; in women, it is usually known as hernia of the labium majus, or as pudendal hernia.

1. **Anterior Perineal Hernia.**—Anterior perineal hernia in the female may escape through a rent in the levator ani, which may be congenital or the result of trauma. The hernia leaves the pelvis by following the lateral wall of the vagina and passing through the triangle bounded internally, by the constrictor vaginae; externally, by the ischio-cavernosus; and posteriorly, by the transversus perinei. The hernia passes down into the posterior portion of the labium majus, and if it descends no further, it is known as a pudendal or vagino-labial hernia. (Fig. 203.) Grattan has recently reported an anterior perineal hernia that descended into the adductor region of the thigh. The diagnosis was confirmed at operation; there was no swelling over the labium. The bladder is usually found in these hernias; small and large intestine, sigmoid, ovary and tube are rare contents.

Although most writers do not subdivide the anterior perineal hernias, or the labium majus or pudendal hernias as they are sometimes called, from an

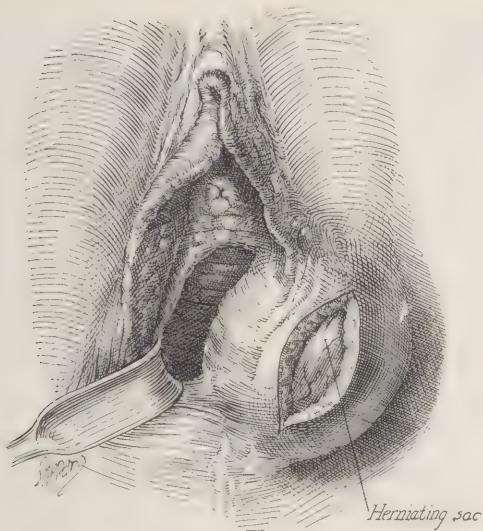


Fig. 203.—Anterior perineal hernia. When the hernia descends only into the posterior portion of the labium majus, it is known as a "pudendal" or "vaginolabial" hernia.

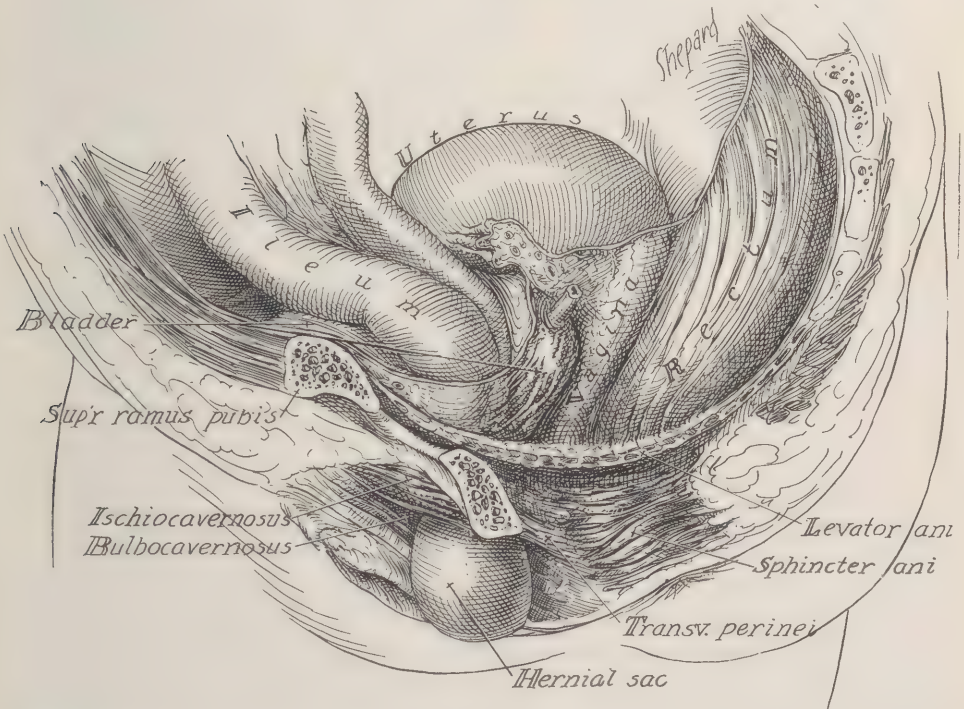


Fig. 204.—Anterior perineal hernia. Mesial section showing the relations of the hernial sac within the pelvis and outside of it.

anatomical standpoint it is most convenient to separate them into the anterior labial and posterior labial varieties.

a. *Anterior labial hernia* passes through the pelvic floor and partly encircles the vagina on its way to the center of the labium majus. This variety is more frequent than the posterior labial hernia. (Figs. 204 and 205.)

b. *Posterior labial hernia* leaves the pelvis through the ischio-rectal fossa and makes its appearance in the posterior part of the labium majus, near the fourchette. Peus has written at length on this variety of perineal hernia.

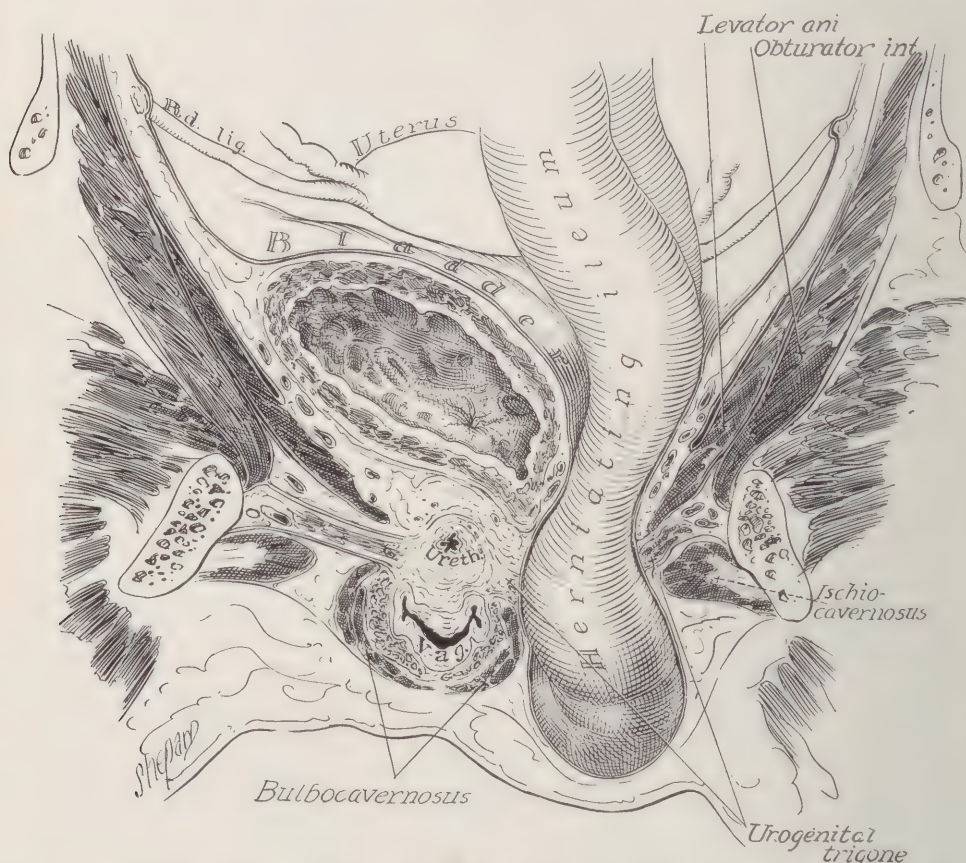


Fig. 205.—Anterior perineal hernia. Transverse section of anterior labial hernia, showing the relations of the sac in its descent to the labium majus.

Contents of the Sac.—The bladder is most frequently found in anterior perineal hernia. In some of the early cases reported it was very large, encircling the vagina more than half way, and occasionally it presented diverticula. Intestine is not often found, and when it is present, it is usually due to a sliding of Douglas' pouch between the levator ani and the constrictor vaginae. Congenital labial hernia of intestine alone has been found in young girls, but it is very rare.

Posterior Perineal Hernia.—Posterior perineal hernia occurs in both men and women, but more frequently in women, when it is often called “retro-uterine hernia,” and may be either vaginal or rectal.

a. *Posterior Perineal Hernia in Men.*—In men posterior perineal hernia descends between the bladder and the rectum, appearing in the ischio-rectal space or in the perineum, usually to one side of the raphé.

b. *Posterior Perineal Hernia in Women.*—Posterior perineal or retrouterine hernia descends between the rectum and vagina, and usually makes its exit through a defect in the levator ani, or between this muscle and the coccygeus. It frequently occupies the ischio-rectal space, and protrudes below the lower border of the gluteus maximus muscle, resembling a sciatic hernia in this respect.

If it remains in the recto-vaginal septum, it may travel in one of two directions, either behind the vagina, pressing the posterior vaginal wall forward (elythrocele), or it may burrow in front of the rectum and force the anterior rectal wall backward, causing a bulging in the rectum (hedrocele). If the hernia is large, it may extend into the perineum causing a protuberance at the margin of the anus, or it may form a tumor in the gluteal region.

In Papen's case there was a bottle-shaped tumor extending from the gluteal region to below the knee, and the sac contained omentum, almost all of small intestine, the lower part of the colon and the right ovary and tube.

c. *Contents of the Sac.*—Intestine and omentum are the most frequently found in the sac. Other viscera that may be present are: Colon, sigmoid, rectum, bladder, cecum, appendix, uterus, ovary and tube.

Etiology

Age.—Perineal hernia occurs most frequently between the ages of 40 and 60, and is most rare between the ages of 10 and 20 years.

Sex.—Anterior perineal hernia almost always occurs in women; posterior perineal hernia is 5 times more frequent in women than in men (Eccles).

Predisposing Causes.—Congenital predisposition is an important factor in perineal hernia. It may be manifested by defects or malformations in the muscles or fasciæ; in women by an abnormal descent of the recto-vaginal fold of Douglas' pouch, and in men by a relaxation of the recto-vesical folds.

The space between the bladder and rectum in males, and between the uterus and rectum in females, is deeper in embryos than in later life. If this cavity persists in the adult, there is a definite predisposition to perineal hernia. Scarpa believed that the elongation of the mesentery and the relaxation of the culdesac are important causes. The relaxation of the peritoneum may be due to pregnancy, obesity, old age, or to collections of fluid in Douglas' pouch.

Intestine may become adherent in the culdesac, and under the influence of strain or injury, it may be forced between the recto-vaginal septum.

Lipomas developing in this region may descend to the perineum, carrying along a peritoneal sac, thus favoring the subsequent development of a hernia.

Other predisposing factors are: Infections involving the pelvic floor, parturition, and difficult labor involving tears or lacerations of the muscles and fascia.

Exciting Causes.—The onset of the hernia is usually sudden; it may follow a fall as in Pipelet's case, or the lifting of a weight, as in the cases reported by Scarpa, Hager, and Wolff. Henno reported the case of a soldier who fell from a height and struck upon the perineum.

Symptoms and Diagnosis

Perineal hernia is nearly always reducible. The tumor is soft and tympanitic if the sac contains intestine alone; and dull on percussion if it contains omentum, bladder or solid viscera. The mass increases in size when the patient stands up or coughs. There may be difficulty in urination if the bladder is in the hernia, as in the case reported by Pipelet, whose patient was a man with an anterior perineal hernia that was caused by jumping a ditch. The tumor was soft, about the size of a hen's egg, and the patient could urinate only by bending forward and pressing on the perineum.

Posterior perineal hernias are divided by Berger into two varieties: In one the hernia appears as a uniform bulging into the rectum or vagina and there is no distinct separation between the hernial sac and Douglas' pouch. This variety is frequently mistaken for a simple prolapse of the rectum or vagina. In the second variety, the hernia is pedunculated. The sac has a distinct neck and strangulation sometimes occurs. This hernia has been mistaken for a vaginal polypus and excised with disastrous results, as in the case reported by Michelson and Lukin. Following the excision of this supposed polypus, the patient became violently ill with vomiting, colic and symptoms of general peritonitis. Death followed in 24 hours.

Vaginal Hernia.—Vaginal hernia usually appears high up on the posterior wall of the vagina and to one side. The swelling may protrude at the vaginal orifice when the patient is standing, and it disappears when lying down. It is usually only slightly painful but it is very uncomfortable, and the tumor tends to increase gradually in size.

Rectal Hernia.—In rectal hernia the anterior rectal wall is forced backward into the rectum; the tumor causes constipation, and there is difficulty in defecation. There is a dragging-down pain in the rectum and as the tumor increases in size it may pass beyond the anus and be mistaken for a prolapse of the rectum.

Strangulated Perineal Hernia.—If the hernia contains intestine there will be a tender irreducible mass, together with constipation, colic and vomiting. The tumor may bulge into both the vagina and rectum, as in the case reported by Petrunti, whose patient had symptoms of strangulation with peritonitis.

An abscess was suspected, the tumor was opened through the vagina, and gangrenous omentum was found in the sac.

Differential Diagnosis

There are several conditions that may simulate perineal hernia:

Abscess.—Abscess presents a fluctuating tumor that is painful, tender and irreducible. Günz mistook a vaginal hernia for an abscess and incised it; the patient died of peritonitis. Woolbert made the same mistake and his patient recovered.

Cyst.—Cysts are soft, fluctuating, painless and irreducible.

Hematoma.—Hematoma of the vulva or vagina is usually traumatic; it presents a tender swelling which is blue or purple, and the skin is tense and shiny.

Lipoma.—Lipoma is usually of slow growth. It is painless, irreducible, and can often be lifted up with the fingers. It is freely movable and has no connection with the deep structures.

Fibroma.—Fibroma, like lipoma, is of slow growth and does not cause symptoms until it is quite large. If it arises from the subperitoneal tissue below and in front of the bladder, it may by traction cause a perineal hernia of the bladder.

Prolapse of the Vagina and Rectum.—Prolapse, on vaginal and rectal examination, will disclose a laceration of the recto-vaginal septum and a bulging mass in the vagina or rectum that is not connected with Douglas' pouch. In hernia, the recto-vaginal septum will be found intact, the tumor can be reduced into Douglas' pouch, and an impulse can be obtained on coughing. When rectal prolapse and hernia occur in the same patient, the hernia appears as a second tumor situated in front of the prolapsed rectum.

Inguinal Hernia.—Inguinal hernia, which descends into the anterior part of the labium majus, on reduction will pass above the pelvic brim and into the inguinal canal, while an anterior perineal hernia of the labium majus reduces backwards toward the uterus, and the inguinal canal is found to be free.

Femoral Hernia.—Femoral hernia on reduction passes upwards into the femoral canal, while perineal hernia reduces backwards, internal to the descending ramus of the pubis, and the tumor can be plainly felt by vaginal examination.

Prognosis

Perineal hernia causes considerable discomfort and may interfere with the patient's occupation, but his life is not in danger unless strangulation occurs. The tumor is usually small. Truss and bandage treatment offer little relief, as they often fail to hold the mass or to check its growth. The best prospect for a cure is offered by abdominal operation. In the presence

of strangulation, immediate operation is imperative. On account of the difficulty of closing the large opening usually found in these hernias, there has been a high percentage of recurrence following the operation. If the muscles are so widely separated that the hernial ring cannot be palpated, operation on nonstrangulated perineal hernia is usually contraindicated.

When hernia complicates pregnancy, the tumor should always be reduced before confinement. There are cases on record where parturition has been made very difficult by neglect of this measure.

Treatment

1. **Mechanical Treatment.**—Bandage and truss treatment, as well as the use of pessaries in vaginal hernias, have generally proven unsatisfactory; but when there are decided contraindications to operation, it is sometimes necessary to employ these appliances.

2. **Taxis.**—Reduction of the hernia can usually be accomplished by pressure on the tumor with the patient in the Trendelenburg position. If the tumor protrudes into the vagina or rectum, reduction through the opening in the pelvic floor will be facilitated by digital pressure in the vagina or rectum.

3. **Radical Treatment.**—Operative treatment of perineal hernia should be undertaken when the general condition of the patient is good, and there is a reasonable assurance that the opening can be closed. Sometimes the pain, discomfort and incapacity are so great that surgical intervention is imperative. In case of strangulation, immediate operation is indicated to relieve the obstruction, and an effort should always be made to close the hernial opening. If prolapse of the uterus or rectum is a complicating factor, appropriate treatment should be undertaken to correct the condition after the hernia is dealt with.

There are two routes for operating on perineal hernias, the abdominal and the perineal:

a. *Abdominal.*—The abdominal approach is usually the operation of choice because it permits an easier reduction of nonstrangulated hernia, and if there is gangrene, the intestine can be resected without the necessity of making a second incision, as would be required if the perineal route were used. The sac can be dealt with to better advantage, and there is a better prospect of closing the hernial opening securely.

The patient is placed in the Trendelenburg position, a median incision below the umbilicus is made, and the hernial opening exposed by free retraction. The hernia is reduced and the sac invaginated by seizing the lower end with a forceps and making traction. If the opening is small, the sac is excised, and the muscle edges are freshened and brought together. In large hernias the sac is folded upon itself and sutured over the muscles to reinforce the closure. Sometimes the central portion of the sac is excised,

leaving an anterior and posterior flap; these are widely overlapped and sutured. (Fig. 206.)

Thomas operated on a large perineal hernia which made its exit through the vulva and extended to the middle of the thighs. After reducing the hernia the sac was invaginated and sutured to the abdominal wall on a level with the lower end of the laparotomy incision, and there was no recurrence. Grattan observed an anterior perineal hernia that extended to the upper part of the thigh. The sac contained the entire sigmoid and was easily reduced; he did not excise the sac. The hernial opening was triangular in shape, and he succeeded in closing it completely with mattress sutures and reenforcing

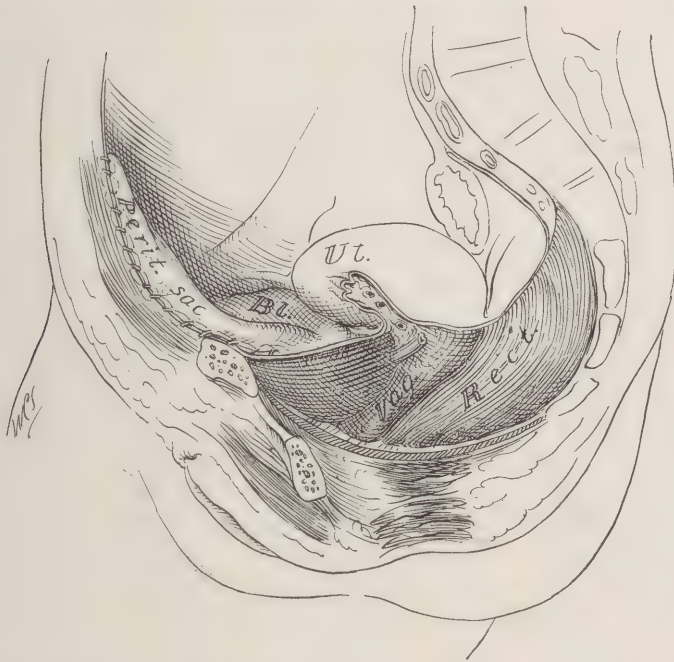


Fig. 206.—Abdominal operation for anterior perineal hernia. The hernia is reduced through the abdominal incision, the sac invaginated and sutured to the peritoneum on a level with the lower end of the laparotomy incision.

it by stitching the broad ligament over it. The sigmoid was sutured to the left psoas muscle to prevent it from returning to the region of the hernial opening.

b. Perineal Route.—The perineal operation should never be used if symptoms of strangulation are present. Although the perineal route is more direct, and affords a better view of the hernia than laparotomy, it also presents more difficulties in closing the internal opening.

The skin incision is usually made external to the constrictor vaginae muscle and parallel to it. Bottini suggested making the incision parallel with the ascending ramus of the ischium. The ischio-rectal fossa is exposed by

blunt dissection; if the orifice in the pelvic floor is large, the incision can be extended backward to the sphincter muscle and the transversus perinei divided. The hernial sac should be opened very carefully, as it frequently contains bladder which is sometimes extraperitoneal. After reducing the hernial contents, the sac is folded on itself by through-and-through sutures and placed in the internal opening to serve as a pad and to strengthen the line of suture. A plastic operation is carried out by using the muscles and fascia, and the hernial opening closed as securely as possible.

Vaginal Hernia.—The operation for vaginal hernia proposed by Huguier, consists of excising the greater part of the wall of the vagina, followed by a plastic operation to close the opening and to give a firm pelvic floor. Reid used this method successfully, but in B. Schmidt's case, it was followed by recurrence. In the case reported by Sweetser, a transverse incision was made at the mucocutaneous junction of the perineum, and another one upon the posterior wall of the vagina as far upward as the cervix. The flaps were dissected back and the hernial sac found at the level of Douglas' pouch. The sac was continuous with the peritoneum and contained cystic fluid which was evacuated; the sac was ligated and excised and the levator ani muscles sutured over the stump. The redundant vaginal wall was excised and the edges sutured; there was no recurrence.

Moschcowitz observed a little girl two and a half years old, who had a posterior perineal hernia, which was not completely reducible, in the ischio-rectal region. With the patient in the prone position and the buttocks elevated, an incision 3 inches (7.5 cm.) long was made over the tumor. In the ischio-rectal fossa there was a lipomatous mass extending upward six inches (15 cm.), through a defect in the pelvic floor that would admit two fingers. The lipoma was excised, along with a small portion of the peritoneal sac to which it was adherent, and the hernial opening closed between the levator ani and coccygeus muscles.

Woolbert observed a strangulated perineal hernia in a man, 44 years old. A hard, tender lump, the size of a bean, appeared to the right of the center of the perineum with symptoms of strangulation as the tumor increased in size. Following incision of the mass there was an escape of feces, and pieces of gangrenous omentum, which also appeared, were excised. The patient recovered, with a small perineal fistula.

Combined Operation.—In certain instances it is necessary to use both the perineal and abdominal routes in operating for perineal hernia. The perineal incision is used to confirm the diagnosis, to free the adhesions in the sac and to reduce the hernia; the abdominal incision is used to deal with complicating conditions, to close the internal opening, and to anchor the sac and hernial contents at a sufficient distance from the opening to lessen recurrence. The operation is concluded with a plastic repair of the muscles of the perineum.

Postoperative treatment should be directed toward keeping the patient's weight down to lessen the danger of recurrence.

Bibliography

PERINEAL HERNIA

- ANSPACH, B. M.: *Gynecology*. Phila. & Lond., Lippincott, 1921, 189-190.
- BARRETT, C. W.: *Hernias through the pelvic floor*. Am. Jour. Obst., N. Y., 1909, lix, 553-569.
- BERGER, P.: *Sur les hernies vaginales et les hernies postérieures de la grande lèvre*. Semaine méd., Par., 1896, xvi, 413.
- BLAKE, J. A.: See Chase, H. C.: p. 717.
- BOCCARD, F.: *Étude sur les hernies du plancher du bassin*. Thèse, Lyon, 1895.
- BOTTINI, E.: *Ernia libera del cavo ischiorettale sinistro*. Clin. chir., Milano, 1895, iii, 338-347.
- CHARDENON: See LeBlanc: *Précis des opérations de chirurgie*. Paris, d'Houry, 1775, ii, 244-252.
- CHASE, H. C.: *Levator hernia (pudendal hernia)*. Surg. Gynec. and Obst., Chi., 1922, xxxv, 717-732.
- CHOPART, F., AND DESAULT, P. J.: *Traité des maladies chirurgicales*. Paris, Villier, 1797, ii, 299-301.
- COOPER, A. P.: *The anatomy and surgical treatment of abdominal hernia*. In two parts. 2nd ed. by C. A. Key, London, Longman, Rees, Orme, Brown & Green, 1827.
- CURADE: See Verdier, C.: p. 25.
- EBNER, L.: *Ueber Perinealhernien*. Deutsche Ztschr. f. Chir., Leipz., 1887, xxvi, 48-112.
- ECCLES, W. M.: *Hernia, its etiology, symptoms and treatment*. New York, W. Wood & Co., 1900.
- GRATTAN, J. F.: *Pudendal hernia*. Surg. Gynec. & Obst., Chi., 1921, xxxii, 131-132.
- GÜNZ, J. G.: *Observationum anatom. chirurg. de herniis libellus*. Lipsiæ, J. C. Langenhemium, 1744.
- HAGER, M.: *Die Brüche und Vorfälle*. Wein. F. Beck, 1834, 308-310.
- HARRINGTON, F. B.: *Hernia of the bladder through the pelvic floor from the traction of a subperitoneal lipoma*. Ann. Surg., Phila., 1900, xxxii, 369-376.
- HENNO, A.: *Hernie périnéale*. Arch. méd. belges, Brux., 1880, 3 s., xvii, 380-382.
- HUGUIER: *Rectocèle vaginal opéré avec succès*. Rev. méd. chir. de Par., 1850, viii, 44-45.
- JACOBSON, L.: *Ueber den Mittelfleischbruch*. J. d. Chir. u. Augenh., Berl., 1826, ix, 393-433.
- LACOSTE: See Ebner, L.: p. 88.
- LAWRENCE, W.: *A treatise on ruptures*. Lond., John Churchill, 1838, 598-605.
- MACREADY, J. F. C. H.: *A treatise on ruptures*. Lond., C. Griffin & Co., 1893.
- MÉRY, J.: See Jacobson, L.: p. 393.
- MICHELSON AND LUKIN: *Ein Fall von Hernia vaginalis*. (Abst.) Centralbl. f. Chir., 1879, vi, 303.
- MOSCHCOWITZ, A. V.: *Perineal hernia*. Surg., Gynec. & Obst., Chi., 1918, xxvi, 514-520.
- MOSCHCOWITZ, A. V.: *Pudendal hernia*. Am. J. M. Sc., Phila., 1918, clvi, 394-404.
- PAPEN, C. H.: *De stupenda hernia dorsali*. Gottingæ. 1750. In: Haller. *Disputationes chirurgicæ selectæ*. Laussannæ, Bosquet. 1755, iii, 313-316.
- PETRUNTI: In: *Bardeleben. Lehrbuch der chirurgie*. 7 ed., Berlin, G. Reimer, 1875, iii, 917-918.
- PEUS, G.: *Ein neuer Fall von Hernia labialis posterior (Hernia subtransversalis)*. Gynaek Rundschau, Berl., u. Wien., 1913, vii, 281-288.
- PIPELET, LE JEUNE: *Sur les hernies de la vessie et de l'estomac*. Mém. Acad. roy. de chir., Par., 1768, iv, 181-200.
- REID, W. L.: *Case of simple enterocele vaginalis posterior; operation*. Glasgow M. J., 1894, xlii, 51-52.
- RICHTER, A. G.: *Abhandlung von den Brüchen*. Göttingen, J. C. Dieterich, 1785, pp. 743-759.
- ROCHARD, E.: *Les hernies*. XV Bibliothèque de chirurgie contemporaine. Richard, A., et Rochard, E.: Paris, O. Doin, 1904, 362-374.
- SABATIER, C.: See Ebner, L.: p. 51.
- SCARPA, A.: *Sull' ernia del perineo*. Memoria. Pavia, P. Bizzoni, 1821.
- SCHMIDT, B.: *Die Unterleibsbrüche*. Stuttgart, F. Enke, 1896, 372-375.

- SEILER: See Ebner, L.: p. 63.
- SMELLIE, W.: A treatise on the theory and practice of midwifery. 5th ed., Lond., Wilson & Durham, 1766, i, 157-159.
- SWEETSER, H. B.: Vaginal hernia. *Ann. Surg., Phila.*, 1919, lxi, 609-612.
- THOMAS, T. G.: Vulvar and vaginal enterocele. *N. York M. J.*, 1885, xlii, 705-711.
- VERDIER, C.: Sur la hernie de la vessie. *Mém. Acad. roy. de chir., Par.*, 1753, ii, 1-58.
- VIOLET, H.: Les hernies pré et rétroutérines dans la constitution des prolapsus. *Lyon chirurg.*, 1909, ii, 439-458; 710-716.
- WALTHER, A. F.: De entero-sarcocele. *Lipsiæ, J. C. Langenhemium*, 1737.
- WINCKEL, F.: Die Pathologie der Weiblichen Sexual-Organe. *Leipz., S. Hirzel*, 1878-81, viii, 285-286.
- WOLFF, C. H.: Ueber Perinealhernien. *I. D. Strassburg*, 1880.
- WOOLBERT, H. R.: Case of strangulated perineal hernia. *Brit. M. J., Lond.*, 1901, ii, 900.

CHAPTER XXIII

HERNIA OF THE LARGE INTESTINE

Synonyms.—Sliding hernia; *Hernie par glissement*; Dry hernia; Landslip or landslide of the large intestine.

Definition.—A protrusion of large intestine through a normal or abnormal opening in the abdomen or pelvis.

While a hernia of the large intestine may escape through any opening in the abdomen or pelvis, this chapter will be restricted to the discussion of the inguinal and femoral varieties. On the right side, the parts usually involved are the cecum, appendix and ascending colon; on the left side, the sigmoid and descending colon. The transverse colon is rarely found, except in umbilical and diaphragmatic hernias, while the upper portion of the ascending or descending colon is usually found in lumbar hernia. (These three varieties of hernia of the large intestine are discussed in the chapters on umbilical, diaphragmatic and lumbar hernia. The very rare varieties of perineal, obturator and sciatic hernia are also considered in their respective chapters.)

Historical

Hernia of the cecum was perhaps first described by Galen. Roussetus, in 1559, stated that he had seen Maupasius expose a cecal hernia during an operation on a bootblack. Geiger, in 1631, stated that cecal hernia occurred most frequently on the right side. Spigelius reported a case in 1645, and in 1680 Blegny remarked upon the rarity of this type of hernia. Johan Otto, in 1688, punctured the cecum in a hernial sac, mistaking it for a hydrocele. In 1732 Arnaud reported a case in a man, 60 years old, with a scrotal hernia of twenty years' duration. His description of the operation resembles some of the case reports in modern literature, in which the surgeon unexpectedly encounters his first case of hernia of the large intestine. Arnaud wrote as follows: "The intestines were adherent to the hernial sac and to each other and were even gangrenous at several points. I have employed one and a quarter hours in dividing the adhesions and bridles (constrictions) that connected the colon to the hernial sac." In order to finish the operation, Arnaud was compelled to cut away the mass at the internal ring, which consisted of the cecum and a portion of the colon and ileum. Of course a fecal fistula followed, but the patient survived.

In 1781 Sandifort recorded a case of congenital scrotal hernia in an

infant three months old, in which the sac contained ileum, cecum and appendix; the latter being adherent to the testis and to the bottom of the sac.

Wrisberg, writing in 1779, believed the descent of the testis was the cause of these hernias. Petit, in 1790, emphasized the difficulty of reducing hernias of the large intestine because of adhesions. Chopart and Desault in 1797, stated that they had seen the cecum bared of peritoneum, lying under the integuments of the scrotum. Sernin saw this same condition later and named it *entérocéle akystique*, or sacless hernia. Tritschler, in 1806, wrote on hernias of the large intestine, but it remained for Scarpa, in 1809-1810, to furnish a classic description of these hernias which he divided into two groups: (1) Hernias due to unnatural adhesions, such as inflammation; (2) hernias due to natural adhesions, "formed by the same bands that fixed the intestine normally in the abdominal cavity, and which are drawn with it into the scrotum." Scarpa's views were adopted by Pelletan, Hesselbach, Cloquet, and Boyer.

Important papers have been published by Malgaigne, Tenain, Bardeleben, Cruvelhier, Luschka, Gosselin, Lockwood, Treves, Duret, Tuffier, Hartmann, Hildebrand, Macready, Savariaud, Foerster, Jaboulay and Patel, Morestin, Weir, Gibbon, Carnett, Lardennois and Okinczye, Baumgartner, Renault, Finsterer, Walton, Hotchkiss, Ransohoff, Labat, Criley, Erb, David, and others.

Statistics

I have collected from the literature 800 cases of hernia of the large intestine (not including hernia of the appendix alone). Of these, 765 were inguinal and femoral, 20 were other varieties, and in 15 the location was not stated.

Age.—The age of the patients was given in 644 cases. Hernia of the large intestine is most common in infants under two years of age, and next in frequency, in subjects from 41 to 60 years of age.

Under 2 years	104
2 to 10 years	67
11 to 20 years	23
21 to 30 years	58
31 to 40 years	57
41 to 50 years	107
51 to 60 years	127
61 to 70 years	59
71 to 80 years	36
81 to 90 years	6
	<hr/> 644

Duration of the Hernia.—The duration of the hernia was stated in 200 cases. It varied from 12 hours to 60 years in the adults. In 31 cases it was congenital; most of these were in infants and children.

Over 50 years	2
41 to 50 years	3
31 to 40 years	6
21 to 30 years	22
11 to 20 years	41
6 to 10 years	25
1 to 5 years	58
6 to 11 months	2
1 to 5 months	8
1 to 3 weeks	1
Less than 7 days	1
Congenital	31
	<hr/>
	200

Thurston reported the case of a man, aged 60, with a right inguinal hernia of the colon, which first appeared with acute symptoms of peritonitis twelve hours before operation.

Robinson observed a woman, aged 33, with a left femoral hernia containing an epiploic appendix, which came down and was irreducible the first time the hernia appeared, four days before operation.

Duration of Acute Symptoms.—In hernia of the large intestine the symptoms of acute inflammation or obstruction are severe from the first:

Over 4 weeks	1
2 to 4 weeks	5
7 to 13 days	10
6 days	2
5 days	6
4 days	6
3 days	8
2 days	13
1 day	32
12 to 23 hours	11
6 to 11 hours	12
1 to 5 hours	7
	<hr/>
	113

The Table on page 502 represents a study of 648 cases of inguinal and femoral hernias of the large intestine, and gives the distribution between the two sexes; the occurrence on the right and left sides; the contents of the sac; and the frequency of sliding hernia.

Anatomy

Cecal hernia is the most frequent variety of the hernias of the large intestine, and the anatomy of the parasaccular and extrasaccular types has been the subject of considerable controversy between anatomists and surgeons. The anatomists are agreed that it is always possible to identify the two fused layers of peritoneum within the abdomen, and that these layers always persist in the extrasaccular or sacless variety. On the other hand, many surgeons have reported cases of unquestionable sacless hernia. (Fig. 207.)

				MALE		FEMALE		RIGHT		LEFT		RIGHT SLIDING		LEFT SLIDING		TOTAL CASES
				I.	F.	I.	F.	I.	F.	I.	F.	I.	F.	I.	F.	
Cecum				225	2	20	9	213	11	32	0	32	0	5	0	256
" Ileum				116	0	3	8	92	8	27	0	8	0	2	0	127
"		Appendix		11	1	5	5	15	6	1	0	0	0	0	0	22
"		Asc. colon		8	0	0	0	7	0	1	0	3	0	0	0	8
"		"		14	0	0	0	5	0	9	0	0	0	0	0	14
"		"		74	1	9	3	60	3	23	1	8	0	1	0	87
"		Trans. colon		4	0	1	0	2	0	3	0	0	0	0	0	5
"		"		8	0	0	0	6	0	2	0	0	0	0	0	8
"		"		3	0	1	0	1	0	3	0	0	0	0	0	4
"		"		"	0	0	0	1	0	1	0	0	0	0	0	2
"		"		87	0	0	0	6	0	81	0	5	0	62	0	87
"		"		11	0	0	0	0	0	11	0	0	0	8	0	11
"		"		9	1	0	0	1	0	8	1	0	0	3	0	10
"		"		1	0	0	0	0	0	1	0	0	0	0	0	1
"		"		1	0	0	0	1	0	0	0	0	0	0	0	1
"		"		2	0	0	0	0	0	2	0	0	0	1	0	2
"		"		2	1	0	0	2	1	0	0	0	0	0	0	3
Total				578	6	39	25	412	29	205	2	56	0	82	0	648

The so-called "extraperitoneal" or "retroperitoneal" position of the ascending colon, resulting from the fusion of the primitive mesocolon with the parietal peritoneum, has caused most of this confusion. Ancel and Cavaillon, as well as other modern anatomists, pointed out that the colon is at no time behind the peritoneum. Carnett stated that the fused layers of primitive mesocolon and parietal peritoneum can be separated always in infants, and usually in adults, and the primitive mesocolon reestablished.

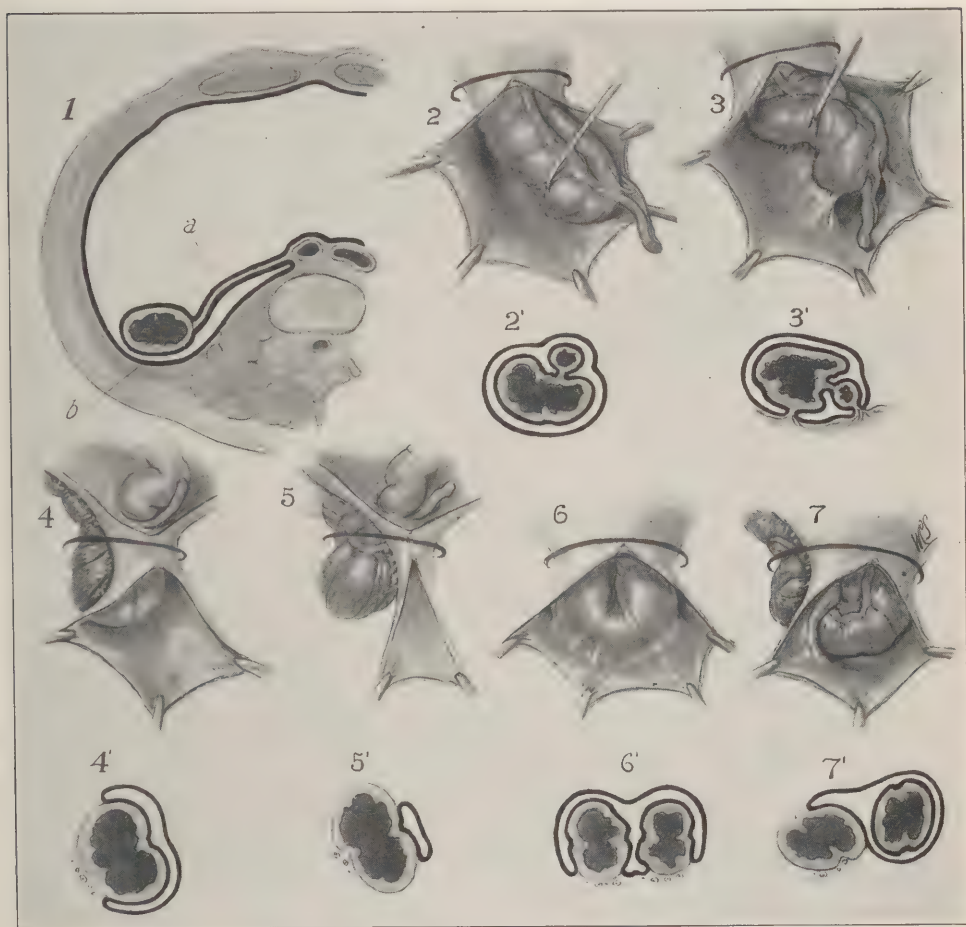


Fig. 207.—The anatomy of sliding hernia of the large intestine.

- (1) The fusion of the primitive mesocolon (*a*) with the parietal peritoneum (*b*).
- (2) Intrasaccular hernia of the free cecum. (2') Mesial section showing relation of the peritoneum.
- (3) Beginning sliding hernia of the cecum. The leaflets of the mesocecum diverge to form the sac wall. (3') Mesial section showing relation of the peritoneum.
- (4) Sliding hernia of the cecum. The cecum is outside of the hernial sac (extrasaccular). (4') Mesial section showing relation of the peritoneum.
- (5) Sliding hernia of the cecum. The cecum has slipped through the hernial ring and remained in the deep cellular tissues and does not bulge into the sac (extrasaccular). (5') Mesial section showing relation of the peritoneum.
- (6) Extrasaccular sliding hernia of a loop of colon. (6') Mesial section showing relation of the peritoneum.
- (7) Intrasaccular hernia of cecum and extrasaccular hernia of descending colon. (7') Mesial section showing relation of the peritoneum.

I believe the explanation of these hernias is simplified by Carnett's suggestion, that the terms "extraperitoneal" and "retroperitoneal" should be reserved for those viscera that lie in contact with the peritoneum, but are at no time surrounded by it (kidneys, ureters, bladder, etc.); and that the terms "retroserous" and "extraserous" should be applied to those viscera which have been, from a practical standpoint, intraperitoneal, but have lost their serous layer on one or more aspects, as a result of fusion (ascending and descending colon, pancreas, duodenum, etc.)

Embryology.—As early as the fifth week in embryonic life, the cecum appears as a small outgrowth of the wall of the primitive gut (mid-gut) before the latter is differentiated into small and large intestines. At about the tenth week the intestines recede into the abdomen, the cecum being near the umbilicus in the midline (see embryology of congenital umbilical hernia). At the eleventh week, while remaining the same width as the small intestine, the cecum is relatively much longer, and the distal or appendix end, from this time on, grows in length, but fails to develop in width.

From its position on the right side of the abdomen, the small intestine grows downward and to the left. About the end of the third month, the large intestine, swinging on its mesentery as though it were a pivot, begins its migration from the left to the right side. According to Huntington, this rotation is due to the growth and increasing length of the intestines. Toldt believed it was caused by the disproportion between the lengthening intestines and the size of the abdominal cavity. The cecum proceeds upward to a position to the left of the midline, just beneath the liver. Gradually traveling to the right, it crosses the descending duodenum, and by the fourth month, it reaches a position beneath the liver on the right side. With torsion completed, the cecum descends, and by the end of fetal life it has usually reached its position in the right iliac fossa. Occasionally it may not descend to its final abode until after birth; in rare instances it reaches the right iliac fossa in the fourth month of fetal life. Should descent be incomplete, the cecum may be arrested in the lumbar region, or at any point below the liver. When the cecum descends too low, it may lie in the pelvis or enter a congenital hernial sac. I want to call attention to the frequent association of hypermobility and maldevelopment, and to the fact that it is easier for a small cecum to enter a hernial sac than for one of normal size. Lockwood found the cecum in the left iliac fossa in several dissections.

In early fetal life, the descending colon lies in the lower part of the abdomen near the midline. When the sigmoid loop forms, it lies across the midline with its convexity upward and to the right. Should the sigmoid deviate toward the right iliac fossa, as it descends to its normal position, it is easier for it to enter a left hernia or even one on the right side.

The Cecum.—The cecum is a blind pouch with its fundus directed downward and its open end upward. It is usually about $2\frac{1}{2}$ inches (6.25 cm.) in length and 3 inches (7.5 cm.) in breadth. Four types have been described

by Treves. The cecum is nearly always entirely surrounded by peritoneum. In 5 to 6 per cent of the cases the peritoneal investment is incomplete, leaving a small area on the upper end of the posterior surface uncovered and connected to the iliac fossa only by connective tissue.

In an examination of 100 subjects, Treves found that the apex of the cecum usually lies a little to the inner side of the center of Poupart's ligament; sometimes it hangs over the brim of the pelvis. In 18 per cent it was entirely within the pelvic cavity. He found that the average distance from the tip of the cecum to the point of reflection of the peritoneum onto the posterior abdominal wall was 4 inches (10 cm.). In one instance it measured 8 inches (20 cm.). The mobility of the cecum was usually pronounced, the degree, however, depending on the distance of the peritoneal reflection from the tip, and on the existence of an ascending mesocolon. In 11 instances the cecum could be made to touch the liver or any part of the left side of the pelvis. In one case it could be made to touch the xiphoid cartilage, and in several instances it would reach down the thigh to the level of the great trochanter.

Jonneseo examined 100 subjects and found the cecum adherent to the posterior abdominal wall (extraserous) in 8. Legueu examined 100 infants and found the cecum extraserous 6 times. Tuffier reported 120 autopsies in subjects of all ages, and found the upper posterior third of the cecum adherent 9 times in adults and old men. In the 100 subjects examined by Treves, the cecum was in no instance found adherent to the posterior abdominal wall.

Ancel and Cavaillon have described three types of cecum:

1. The mobile cecum, which is entirely surrounded by peritoneum and is free in the abdomen. This type is frequently found in the newly born (45 per cent), but seldom persists into adult life (7 per cent).

2. The attached cecum, which is closely adherent to the posterior parietal peritoneum. Even though attached to the parietal peritoneum, the cecum still remains intraperitoneal from the developmental standpoint, and is not subperitoneal, as it is claimed to be by some. This variety was found in 73 per cent of the adults, and in 48 per cent of the newly born.

3. The cecum with a mesentery, the latter being derived from a fusion of the two layers of the common mesentery with the two layers of parietal peritoneum. This third type, which is a natural development from the mobile cecum of early life, is seldom found except in the aged.

The Mesocolon.—The mesenteries of the large and small intestines are continuous at first and are attached to the spine. When the intestinal loop rotates around the superior mesenteric artery, it carries the beginning of the large intestine and its mesentery to the right across the duodenum. This rotation partially cuts off a fan-shaped portion of the general mesentery that lies within the concavity of the loop; and this portion later on, forms the mesentery proper in the adult.

At first, this fan-shaped portion of the mesentery is continuous by the right border with the mesentery of the ascending colon, which is a part of the primitive mesentery (which is similarly continued into the mesentery of the transverse, descending, iliac and pelvic colons). Subsequently, the back of the mesenteries of the ascending, descending and iliac portions of the colon adhere to the posterior abdominal wall, and these mesenteries become lost; while the mesenteries of the transverse and pelvic portions of the colon remain free, and persist into adult life.

At the same time, the mesentery proper (which was at first attached only by its narrow neck, between the duodenum and transverse colon, and below this point was continuous on the right, with the ascending mesocolon) acquires a new attachment to the posterior abdominal wall through the absorption by the ascending mesocolon, and the adult condition is attained. When the primitive ascending or descending mesocolon persists, there is considerable mobility of the colon, as well as of the cecum and sigmoid, and this favors the occurrence of hernia.

1. *The Cecum*.—The cecum has no mesentery, because the mesentery of the ileum passes direct to the ascending colon, leaving the cecum and appendix free and entirely surrounded by peritoneum.

2. *The Ascending Colon*.—When the ascending colon reaches its position in the right iliac fossa, the posterior layer of its mesentery, along with the layer of parietal peritoneum behind the mesentery, degenerate into areolar tissue and the two fuse together, thus forming the attachment of the ascending colon to the posterior abdominal wall. Sometimes the lower quarter or third of the ascending colon is covered by peritoneum. As a rule, only about two-thirds of the circumference of the upper part is invested by peritoneum.

3. *The Transverse Colon*.—The transverse colon is completely surrounded by peritoneum and is attached to the transverse mesocolon. It is found in umbilical, ventral, and diaphragmatic hernias, rarely in hernias of the lower abdomen or pelvis.

4. *The Descending Colon*.—The descending colon is often attached to the posterior abdominal wall and not covered behind by peritoneum. Treves found a descending mesocolon 36 times in 100 examinations. Lesshaft found a mesocolon in only one out of 6 subjects. Symington maintained that the loose, lax peritoneum is often mistaken for a mesentery.

5. *The Sigmoid*.—The sigmoid usually has a mesentery and in this case, it is entirely surrounded by peritoneum. Sometimes the upper portion of the sigmoid is closely adherent to the left iliac fossa as far as the brim of the true pelvis. When there is a descending mesocolon, the sigmoid nearly always has a well-developed mesocolon; the sigmoid is freely movable, and it is easy for it to enter a hernial opening, especially on the left side. Treves found the mesocolon in a hundred subjects as follows:

Ascending mesocolon only	12
Descending mesocolon only	22
Ascending and descending mesocolon	14
No ascending or descending mesocolon	52

Pathology

Hernias of the large intestine are divided into two varieties: Congenital and acquired.

1. Congenital Hernias.—The congenital hernias include nearly all of those with complete sacs. They resemble ordinary hernias in that the cecum



Fig. 208.—Right inguinal hernia of the cecum, appendix and ascending colon. The appendix is gangrenous.

has a mesocolon and descends into a preformed sac. The cecum is entirely covered with peritoneum; it is movable and can be easily drawn into the sac. Besides the cecum, the sac may contain the appendix, ascending colon, sigmoid, descending colon, transverse colon, omentum, small intestine, or other viscera. Inflammation often develops early, and intrasaccular adhesions cause irreducibility. (Fig. 208.)

Adhesions between the cecum and the testis may be responsible for con-

genital cecal hernia in certain cases. The first case of embryologic attachment between the cecum and the testis was observed by Sandifort. Shortly after this case was reported, Wrisberg advanced the theory that the descending testis could pull the cecum into the inguinal canal by its traction on the plica vascularis.

At the seventh month of fetal life the testis lies in the abdominal cavity near the internal ring. The mesorchium (or plica vascularis) consists of two layers of peritoneum that envelop the spermatic vessels, and terminate on the right side in the appendix, cecum, ileum or primitive mesentery. On the left side, the plica vascularis is attached to the sigmoid. The descent of the cecum has been compared to the descent of the testis, by Meckel and others. This comparison is of little or no value, because the testis is retroperitoneal, while the cecum is usually intraperitoneal.

When the cecum is drawn into the inguinal canal by the testis, the adhesion does not occur until the testis has descended below the lumbar region. If the cecum develops adhesions early, it will become affixed to the immovable kidney, and will be unable to reach even the right iliac fossa.

The peritoneal fold of the plica vascularis disappears, but some of its smooth muscle fibers persist as the internal cremaster muscle. Lockwood attached more importance to the finding of smooth muscle fibers connecting the testis to the cecum or sigmoid, than to the existence of the peritoneal fold, which is usually absent. When this fold has not been obliterated, it appears as a ridge on the inside of the posterior sac wall. In case the cecum and appendix migrate early to the right iliac fossa (in rare instances by the fourth month), they may become adherent to the posterior parietal peritoneum that overlies the gubernaculum or testis, and when the testis accompanied by its processus vaginalis descends through the inguinal canal, the peritoneal adhesions drag down the cecum and form a congenital hernia (Wrisberg, Cloquet, and Lockwood).

2. Acquired Hernias.—Acquired hernias include those in which the sac is partially or completely attached:

a. *Simple Acquired Hernia.*—In simple acquired hernia, the cecum is entirely covered by peritoneum and lies free in the sac, the same as an enterocele or an omentocele.

b. *Sliding Hernia.*—Sliding hernias of the cecum are the most common variety, and the most difficult to deal with from an operative standpoint. The older writers thought that the cecum slipped underneath the peritoneum, but this theory has been abandoned. In order for the cecum to become extraperitoneal or retroperitoneal, the layers of the primitive mesentery would have to be separated before the cecum could enter the subperitoneal tissues, and this, of course, is an impossibility. For this reason I prefer to classify hernias of the large intestine, according to their relation to their serous covering, and not according to their peritoneal relation; the latter classification is inaccurate and has led to considerable confusion in the past.

1. **Intrasaccular Hernia (Hernia with Complete Sac.)**—Intrasaccular hernia has a sac formed from the parietal peritoneum that surrounds the peritoneal-covered cecum. The cecum may enter the sac as a result of a ptosis of the colon because of relaxation of the ligaments of the colon; or because the colon or cecum has a long mesentery. This mesocolon may appear to be inserted into the sac wall. The cecum is usually elongated and directed downward and inward.

Rochard classified intrasaccular hernias into three stages, depending on the insertion of the mesentery: In the *first* stage, the cecum or sigmoid is free in the sac and there is no mesentery attached to the sac wall. In the *second* stage, which is more often encountered, the cecum or sigmoid is attached to the walls of the sac by a mesentery that does not descend to the base of the fundus of the sac. In the *third* stage, the mesentery descends to the fundus of the sac.

The mesentery may be long or short, and contains the vessels and nerves that supply the intestine. When the mesentery is attached to the sac it constitutes the "natural fleshy adhesion" of Scarpa, and is the cause of the irreducibility of the hernia. This mesentery cannot be cut because it furnishes the blood supply to the intestine. Intrasaccular hernias are usually easily reduced, while the parasaccular and extrasaccular varieties are irreducible or partially so.

2. **Parasaccular Hernia (Hernia with Incomplete Sac; Hernia with Sac Partially Attached).**—Parasaccular hernia is a variety in which the intestine lies behind the walls of the sac, usually to the outer side. The cecum is covered by peritoneum on its anterior and internal surfaces; this covering also forms the posterior and external walls of the sac and it is continuous with the rest of the sac. The entire sac was originally a portion of the parietal peritoneum. On account of the adhesions between the cecum and the sac wall, many of the early writers believed that the peritoneal sac was incomplete, especially when a small sac was found in a large hernia. Carnett pointed out that parasaccular hernias are extraserous, but many of the French writers describe two types of parasaccular hernia:

a. *The cecum appears to have been misplaced in sliding.* Its superior portion may point toward the abdomen, with its base directed downward; or, it may appear to rotate forward on its longitudinal axis so that its "adhesion" is in front. Rochard stated that it is the serous covering of the intestine in the hernia which is incomplete, and not the sac itself. If the ordinary hernia incision over the most prominent part of the tumor is employed, the cecum or sigmoid may be exposed and the serous covering mistaken for the sac.

Parasaccular hernia differs from ordinary (or intrasaccular) hernia in that it has a layer of parietal peritoneum closely adherent to a layer of visceral peritoneum, covering the intestine on one side.

b. *Hernia by Basculation* (*Hernie par Bascule; Rocking-Chair Hernia*).—Hernias by basculation are those in which the ascending colon is first to descend, and draws the cecum along with it. That portion of the cecum attached to the colon is the first to enter the hernia, while the base may remain in the abdomen above the hernial ring, or finally descend as the mass becomes larger. The base of the cecum forms an angle with the colon, hence the term, “basculation.” When the cecum has a mesentery and retains its peritoneal covering in the hernial sac, it is of the intrasaccular variety; if the cecum slides into the hernia and loses a part of its serous covering, it becomes parasaccular, and if it is deprived of all of its serosa, it becomes a sacless hernia.

Primary and Secondary Sliding Hernia.—The sliding of the cecum may be primary when the cecum enters the sac first; or secondary, when the ileum or ascending colon precedes the cecum and draws it into the sac. Scarpa first called attention to this secondary form.

3. Extrasaccular Hernia (Sacless Hernia; Hernia without a Sac: Hernia with Sac Completely Detached).—Sacless hernias are very rare and only a few cases have been reported. I collected 14 cases from the literature. The intestine enters the hernia without its serous covering and lies in the cellular tissue.

Traumatic sacless hernia with the intestine escaping through a rent in the parietal peritoneum is probably more frequent than the spontaneous variety. It is possible that some of the reported cases of sacless hernia were in reality parasaccular; it is easy to overlook a small peritoneal diverticulum or sac located near the internal ring.

The Sigmoid Flexure.—The sigmoid flexure is situated in the left iliac fossa and is 13 to 17 inches (32.5 to 42.5 cm.) long. It is divided into 2 parts, known as the iliac colon and the pelvic colon. It is retained in position by the sigmoid mesocolon. The pelvic portion of the mesocolon is almost always present, but the iliac portion is occasionally lacking; Treves found the iliac mesocolon absent in 9 out of 100 subjects. The sigmoid is freely movable, especially the pelvic portion, and it can often be drawn easily into an inguinal or femoral hernial opening on the left side. In rare instances it has been found in right-sided hernia.

The lower part of the iliac colon or the portion at the ilio pelvic junction is the part usually found in hernia of the sigmoid. Because the sigmoid usually has a mesocolon, parasaccular hernias are infrequent and sacless hernias very rare. Because of the size of the sigmoid, it does not enter a hernial opening as often as the cecum does. The sigmoid requires a large hernial opening and when it is in the sac alone, it presents a double loop or double-gun-barrel appearance, while the cecum appears in the sac as a single loop. As the sigmoid descends it may drag with it the colon, omentum, or small intestine; in rare instances, the large intestine from the right side may be drawn into the sac as a result of inflammatory adhesions. (The vari-

eties of hernias of the cecum already described are also found in hernia of the sigmoid.)

Bilateral Hernia of the Large Intestine.—Bilateral hernia of the large intestine is very rare and only a few cases have been reported.

Changes in Position of Other Structures.—Very rarely the aorta or inferior vena cava bends slightly toward the side of the hernia. Apparently this is due to traction on the mesenteric vessels caused by the hernia. Tuffier reported several cases in which ptosis of the kidney occurred on the same side with the hernia.

Etiology

The principal predisposing causes of hernia of the large intestine are age and sex. These hernias usually occur in middle-aged or elderly men, most commonly on the right side, and nearly always in the inguinal region. (Embryologic causes of hernia of the large intestine have already been considered in the section on anatomy.)

Age.—Hernias of the large intestine are most frequent in infants under 2 years of age, and next in frequency in subjects from 41 to 60 years of age. In my series of 800 cases the age was given in 644 as follows:

Under 2 years	104
2 to 10 years	67
11 to 20 years	23
21 to 30 years	58
31 to 40 years	57
41 to 50 years	107
51 to 60 years	127
61 to 70 years	59
71 to 80 years	36
81 to 90 years	6
	<u>644</u>

Sex.—Hernias of the large intestine almost always occur in men. The following table shows the distribution between the two sexes; the occurrence on the right and left sides; and the frequency of sliding hernia, in 648 of the cases I collected from the literature:

	MALE	FEMALE	RIGHT	LEFT	RIGHT SLIDING	LEFT SLIDING
Inguinal	578	39	412	205	56	22
Femoral	6	25	29	2	0	0

Frequency.—It is impossible to say how common hernias of the large intestine are, because only the irreducible or strangulated ones are reported; and many of the reducible hernias are not even diagnosed at operation.

Thurston stated that right-sided hernias of the large intestine are very common in India. Brunner made a study of 417 cases and found hernia of the large intestine in 6 per cent; this percentage is very high, probably due to the fact that at the time of his report, operative treatment was not gen-

cally resorted to. Ehler reported 188 cases of inguinal and femoral hernia. He found the cecum in the sac in 9 cases, and the appendix in one; 2 of these cases were left inguinal hernias and 3 were sliding hernias.

Schulz found sliding hernia 10 times in 286 cases of hernia. Hilgenreiner found 84 hernias of the large intestine in 2,238 operations for hernia. Brenner found sliding hernia of the sigmoid 20 times, and of the cecum 39 times in 3,000 operations for hernia. Sprengel found 18 sliding hernias in 1,800 hernias. Petrovic found 14 sliding hernias in 1,325 operations for hernia. Kirchner found 15 cases in 500 hernia operations. In 220 operations Coley found the cecum alone 18 times; the appendix alone 10 times, and the cecum and appendix 7 times.

Lardennois and Okinczyk stated that 40 per cent of the strangulated hernias in the newly born and 27 per cent of those in children contain large intestine, usually the cecum; while 3 per cent of the simple hernias in children and 6 per cent of those in adults contain a portion of the large intestine. Estor reported 104 cases of strangulated hernia in the newly born; in 5 of these the cecum was alone; in 11 the cecum and appendix were together; in 9 the cecum and appendix were accompanied by a loop of small intestine; in 6 the cecum and the terminal portion of the ileum were together; and in 1 the cecum and part of the ascending colon were together.

Site of Hernia.—The usual points of exit for hernias of the large intestine are the inguinal, femoral, umbilical, ventral, diaphragmatic, perineal, obturator and sciatic openings. (Only the inguinal and femoral hernias are considered here, as the others are dealt with in their respective chapters.)

In 648 cases I collected from the literature, 412 were right inguinal, and 205 left inguinal; 29 right femoral, and 2 left femoral.

Congenital Hernias of the Sigmoid.—Hernias of the sigmoid flexure are rarely congenital, even when the mesocolon is well developed. This fact is probably due to the large size of the sigmoid; of 117 hernias of the sigmoid in my series only 4 were congenital. It is exceptional for adhesions to exist between the cecum or sigmoid and sac wall, in infants and children.

Anatomic Causes.—The following anatomic factors act as the principal predisposing causes of hernia of the large intestine:

1. Abnormal position of the bowel.
2. Unusual length of the peritoneal attachment of the intestine.
3. Distention of the intestine.
4. The descent of the ileum into a hernia may draw the cecum, appendix and ascending colon after it.
5. An appendix adherent in a hernial sac may drag down the cecum and ascending colon.
6. Congenital causes, such as adhesion of the cecum or sigmoid, to the descending testis.

Finally, more than one of the above factors may exist in one subject.

Sliding Hernia.—Sliding hernias are due to a slipping of the posterior parietal peritoneum on the underlying cellular tissue. The peritoneum slides into the internal ring, carrying with it the attached loop of large intestine. As a rule, true sliding hernias of the descending colon and sigmoid occur only on the left side; and sliding hernias of the ascending colon and cecum are found only on the right side. When these viscera are found on the sides opposite from their normal positions, it is nearly always due to a loosening of their attachments; to an abnormally long mesocolon, or to an elongation of the bowel itself.

The principal stages of sliding hernia are the following: Sliding, ptosis, descent, basculation, and deperitonization. The sliding or gliding involves the cecum or sigmoid and its colon and mesocolon, with their peritoneal covering. The intraabdominal pressure is one of the most important factors influencing the sliding of the intestine toward the hernial orifice. Sometimes there is an accompanying ptosis of the kidney on the same side as the hernia, as well as a deflection of the inferior vena cava and of the aorta, toward the same side.

Ptosis of the large intestine or other viscera is often found in very large hernias. Congenital hernias of the large intestine are often due to the dragging of the mass of omentum into the hernial sac. The traction exerted by adherent omentum or intestine in the sac is also a causative factor. Visceroptosis is certainly not an important predisposing cause of hernia of the large intestine; if it were, these hernias would be more common in women.

The descent of the hernia once it has reached the ring is progressive, being aided by the relaxation of the ligaments of the colon and the weight of the intestinal contents. This regular, constant pull or pressure gradually forces the bowel down to the hernial ring and through it; in contradistinction to the exciting causes of ordinary hernia, namely, straining, lifting, trauma, etc.

Causes of Left-sided Cecal Hernia.—Left-sided cecal hernias are uncommon and they are nearly always intrasaccular. Parasaccular and extrasaccular (sacless) hernias are very rare. Left cecal hernias are probably always due to congenital transposition of viscera, or to malposition of the cecum combined with adhesion of the cecum to the parietal peritoneum on the left side.

Other causes of cecal hernia are the following: A long ascending mesocolon; traction from the ileum; adhesions between the cecum and omentum or small intestine; failure of the cecum to rotate from the left side to the right side in embryonic life; ptosis of the large intestine; scoliosis and kyphosis.

Right-sided Hernia of the Sigmoid.—Right-sided hernia of the sigmoid occurs occasionally and may be due to one of the following causes: An abnormally long mesocolon; congenital transposition of viscera; traction from

adhesions between the sigmoid and omentum or intestine already in the sac; enteroptosis; scoliosis and kyphosis.

Symptoms and Diagnosis

1. Functional Symptoms.—The functional symptoms of hernia of the large intestine are similar to those of hernia of the small bowel, and are not well defined if the hernia is reducible. When the cecum, sigmoid or colon is in the hernia and is irreducible, the symptoms are more marked, and consist of constipation, attacks of partial obstruction, pain in the hernial mass and colicky pain with occasional attacks of diarrhea. Campenon reported a case of right-sided hernia of the large intestine in which it was necessary for the patient to reduce the hernia before the bowels could move.

When the symptoms are not well defined the diagnosis is very difficult, and for this reason the majority of cases reported have not been diagnosed prior to operation. Bérard, in 1827, pointed out the value of using an enema in the diagnosis of left-sided hernia of the sigmoid. He found that in case of strangulation, only a few spoonfuls of fluid could be injected. However, with present-day methods of diagnosis, this maneuver should never be resorted to because of the danger of rupturing the intestine.

2. Objective Signs.—In the infant the tumor is usually large, out of proportion to the size of the child, and oval in shape. In the adult it is also very voluminous and tends to increase progressively in size. It is usually pyriform or oval in shape and occasionally bilobular. The neck of the sac is nearly always large and distended by the thick pedicle of the sac contents. As a rule, the signs are those common to all intestinal hernias. It is possible only occasionally to recognize the sac contents by palpation. Sometimes the appendix can be felt in children, and it can be distinguished in adults in rare instances when the hernial coverings are very thin. The appendices epiploicae are sometimes palpable.

Sometimes the examiner can make out an abnormally small amount of large intestine in the iliac fossa by means of palpation and percussion. Reduction of the hernia is usually accompanied by pain, and reduction becomes more difficult as the hernia increases in size. Irreducibility may be due to the formation of inflammatory adhesions in the sac, or to the descent of the mesocolon into the hernia. The roentgen-ray is a valuable aid in diagnosis and will sometimes succeed when other methods fail. Morestin used it successfully, and Marchetti was able to diagnose a sciatic hernia of the sigmoid before operation, from the roentgen-ray pictures.

In boys, a congenital hernia of the large intestine that has been reduced, can often be reproduced by traction on the testis.

Complications.—The principal complications of hernia of the large intestine are intestinal obstruction, strangulation and peritonitis in the hernial sac. The rare complications are, a hydrocele in the sac, intussusception of

the small intestine, hematoma, tuberculosis, and malignancy of the colon in the hernia.

1. *Obstruction*.—Obstruction may occur in a partially reducible hernia or in an irreducible one. It is usually preceded by increased pain, colic, and other symptoms of obstruction referred to the mass, which is often very large and has sometimes lost its "right of domicile." The hernia is nearly always sensitive to the touch, quite firm, and often tympanitic on percussion. Nausea and vomiting are common and usually do not subside until the bowels act. The attacks of pain and obstruction have a tendency to recur, and it is sometimes impossible to distinguish obstruction from the symptoms of beginning strangulation.

2. *Strangulation*.—On account of the large hernial opening, strangulation is rare, occurring much less often than obstruction. The symptoms are at first mild, perhaps attracting little attention. Their course is progressive; nausea and vomiting increase, and if the entire lumen of the intestine is occluded, there is absolute constipation and no gas passes the obstruction. The life of the patient depends on prompt diagnosis and immediate operation. In partial enterocele constipation is not complete and the symptoms are less severe, but there is always the danger of gangrene of the strangulated intestine with fatal peritonitis. Both large and small intestine may strangulate in the same sac, or only one or the other. When the appendix is in the sac it is generally the site of adhesions and inflammation.

3. *Peritonitis in the Hernial Sac*.—Peritonitis is the natural sequela of untreated strangulated hernia. Infection occurs early and inflammation rapidly spreads, involving other sac-contents. The peritonitis is usually confined to the sac by adhesions at the neck of the sac. However, because of the large hernial opening, the infection spreads to the abdomen more frequently than in isolated hernia of the appendix. When the appendix is alone in the sac, the ring is usually very small. If the patient lives, hernial peritonitis generally terminates in abscess formation and a fecal fistula.

The most frequent cause of hernial peritonitis is appendicitis in the hernial sac. (This subject is considered in the chapter on hernia of the appendix.)

Royer reported an interesting case of temporary incarceration of the transverse colon in inguinal hernia: The patient, a man aged 35, complained of pain and discomfort in the left side of the abdomen in the lumbar region. The pain came on at a variable time after eating and was relieved only by an enema. Roentgen-ray examination at the end of the 24-hour period, showed filling of the large bowel from the cecum to the left extremity of the transverse colon, but only a small amount of barium in the descending colon and sigmoid and none in the splenic flexure. Bilateral inguinal hernias were found. A later examination with the hernias reduced showed the transverse colon in its normal position.

Differential Diagnosis

Hernia of the large intestine must be differentiated from other varieties of hernia, especially from hernia of the small intestine, omental hernia, hernia of other abdominal and pelvic viscera, and hydrocele. (The differential diagnosis of these is taken up in the chapter on differential diagnosis of inguinal hernia.) The surgeon should be on his guard for hernia of the large intestine in all voluminous hernias; when the hernia is incompletely reducible; when the patient cannot tolerate a truss; when there is no gurgling on reduction because of the large hernial rings, and when there are signs of considerable gas in the bowel within the sac.

The Bladder.—Hernia of the large intestine is sometimes mistaken for hernia of the bladder, especially if the mass is small. Urinary symptoms are usually present in bladder hernia and the irreducible portion of the tumor lies to the inner side of the reducible part; while in hernia of the large intestine, the irreducible portion is on the outer side of the reducible part. Richards reported a case in which the distended cecum lying in a serotal hernia was diagnosed, by another physician, as hydrocele, and tapped with disappointing results. Fortunately the cecum was adherent to the sac wall and no harm resulted.

Prognosis

The prognosis of hernia of the large intestine is more serious than in hernias of the small intestine. Truss treatment is usually unsatisfactory, and on account of the large size of the hernial opening it is difficult or impossible to keep the hernia reduced. Besides being the source of considerable pain and discomfort, the volume of the hernia and its tendency to become irreducible seriously affect the general health and earning-capacity of the subject. Operation is the treatment of choice. Hernia of the sigmoid flexure usually presents more operative difficulties than hernia of the cecum.

I collected from the literature 528 cases of hernia of the large intestine treated by operation. The large intestine was reduced in 505 cases, with 469 recoveries and 36 deaths; and it was resected in 23 cases with 10 recoveries and 13 deaths. The appendix was excised in 150 cases, with 8 deaths; and it was reduced in 28 cases with two deaths later from appendicitis.

There is little prospect of cure from truss treatment even in infancy and early childhood on account of the large hernial ring, and for this reason operation is to be advised as early as possible.

Local Anesthesia.—The prognosis from an operative standpoint depends largely on the choice of the anesthetic. Local anesthesia not only lowers the mortality rate in the young and robust, but it also offers to the aged and to the otherwise handicapped patient a prospect of cure without the dangers and discomforts of general anesthesia. For aged patients, if local anesthesia is not available, spinal anesthesia is to be preferred to general anesthesia.

The operative treatment of intrasaccular hernias of the large intestine presents no unusual difficulties; and the prognosis is as good as in massive hernias of the small intestine, in the former, however, there is greater danger of recurrence, because of the large hernial opening and the tendency of the large intestine to descend and break through the closed hernial ring, unless the prolapsed intestine is anchored to the abdominal wall by a colopexy.

The operation for parasaccular and extrasaccular (sacless) hernias presents unusual difficulties in that it is hard to locate the sac. There is great danger of wounding the intestine or its blood supply, and the dissection and reduction of the intestine is tedious and complicated. The prognosis of strangulation is particularly grave; fortunately the condition is rare.

Treatment

The radical operation is the treatment of choice for hernia of the large intestine. The indications for mechanical treatment are considered in the chapters on inguinal and femoral hernia, and it is sufficient to state here that, as a rule, truss treatment or other palliative measures are unsatisfactory on account of the large hernial opening. Even in infants there is a small prospect of cure by mechanical means.

Preoperative Treatment.—The preoperative treatment of massive hernias of the large intestine is very important, especially when they are irreducible and have lost their “right of domicile” in the abdomen. (This subject is discussed in detail in the chapter on umbilical hernia.) It is only necessary to remark here, that if this preoperative treatment is neglected the mortality will be unnecessarily high. Of course, in strangulated hernia immediate operation is imperative.

Contraindications to Operation.—The contraindications to operation on hernias of the large intestine are about the same as those that apply to massive inguinal hernias. Usually the operative treatment is not to be advised when the hernia is voluminous, when it has been irreducible for a long time and has lost its “right of domicile” in the abdomen; and when the patient is very old, or when the hernia is complicated by advanced cardiovascular, renal or pulmonary lesions. However, certain of these contraindications do not maintain when local anesthesia is employed.

The Radical Operation.—From the standpoint of the operative treatment, it is most convenient to divide hernias of the large intestine into two groups:

1. *Intrasaccular Hernia.*—The operation for nonadherent hernias, both in infants and adults, is similar to the one already described in the chapters on inguinal and femoral hernia. When there is a considerable loop of ascending or descending colon in the sac, it is sometimes necessary to make a lateral rectus incision and fix the colon to the posterior abdominal wall (colopexy) to prevent recurrence.

2. *Parasaccular and Extrasaccular (Sacless) Hernia.*—The same general principles of operation that apply to other hernias hold good for adherent hernias. The incision should be large enough so that the operator can see each structure clearly before he cuts it. It is often difficult to find the sac and unless the possibility of a sliding hernia is borne in mind, there is danger of incising the intestine in mistake for the sac. As a rule, in left-sided inguinal hernias, the sac is found behind and to the outer side of the mass, and in right-sided hernias it is usually situated in front and to the inner side. The possibility of an extraperitoneal bladder hernia is always to be thought of, and there is a remote chance that the extrasaccular intestine may have rotated forward to a position in front of the sac.

In sacless hernias the peritoneal covering is absent and the muscular coat of the intestine is more easily recognized than the fused peritoneal covering of the extrasaccular hernia. Sometimes the intestine can be recognized by its thick red wall, which bleeds easily when cut and is frequently covered with a layer of fat. However, inflammatory changes may make the intestine very difficult to identify.

If the sac cannot be positively identified after freely exposing the mass at the internal ring, the hernia incision should be prolonged upward beyond the internal ring and the abdomen opened above the hernia. This herniolaparotomy incision permits the operator to inspect the hernia from within the abdomen; to locate the small sac, which is nearly always present; and in some instances, to withdraw the loop of colon from the hernia.

Locating the Sac.—When the hernia is identified it should be opened high up, as near the neck as possible, because if the sac is small this incision gives the best chance of finding it. To locate the sac with the least trauma to the intestine, a thin place in the suspected sac should be selected and held up to the light to ascertain if it is transparent. Sometimes the presence of intestine can be determined by rolling the two walls of the suspected sac between the thumb and fingers.

Freeing the Adherent Intestine.—The sac should be incised along its anterior surface because the nutrient vessels usually lie behind the intestine. (Fig. 211.) After the extent of the intestinal adhesions both inside and outside of the sac is determined, the colon is located; from a point above the neck of the hernia, working from above downward, an attempt is made to find a line of cleavage so that the intestinal loop can be freed along with its mesentery. In case inflammatory adhesions obliterate the line of cleavage, it may be necessary to continue the dissection downward entirely in the deep cellular tissues, so as to avoid injury to the blood supply of the colon, which is extrasaccular, being behind and to the inner side of the intestine.

The sac must not be separated from the colon, as this would destroy the blood supply and gangrene would follow. Before resecting any part of the sac, it should be held up to the light to determine whether or not it contains

vessels. In operating on hernia of the large intestine, it is sometimes possible to identify the large bowel as it is darker in color than an ordinary hernial sac, and its distal end can be traced back into the abdomen.

Reducing the Intestine.—After the loop of intestine has been freed it is usually a simple matter to return it to the abdominal cavity, especially if the patient is placed in the Trendelenburg position. Should the intestine be torn or wounded, the rent should be repaired, and if there is gangrene the necrotic area must be resected.

“Hernie par Bascule.”—In reducing hernias by bascule, involving the colon and cecum or the colon and sigmoid, the part that came down last

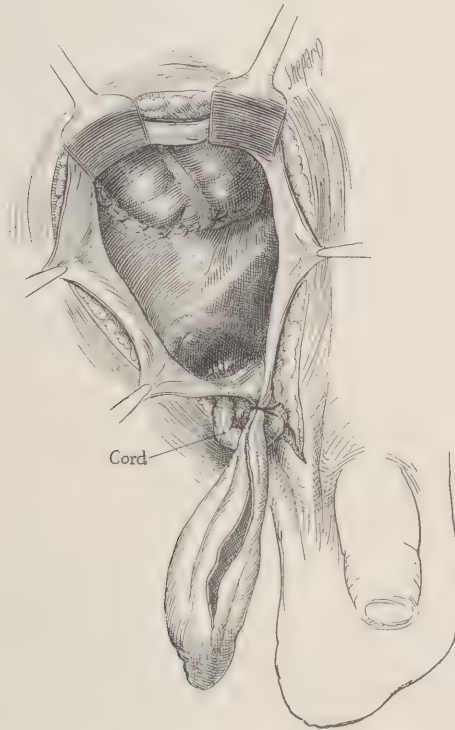


Fig. 209.—Operation for sliding hernia of the large intestine. Cecopexy. To lessen the danger of recurrence it is usually advisable to anchor the mobile colon in the iliac fossa, as high as possible above the hernial opening.

should be reduced first. The colon is reduced by making pressure upward and forward on the posterior surface of the hernia, followed by pressure downward on the anterior surface. Finally, the cecum or sigmoid is reduced.

Reconstruction of the Mesocolon.—When conditions permit, some surgeons advise reconstructing the mesocolon either with or without fixation to the abdominal wall. After resecting a portion of the sac, a mesocolon is formed by turning the edges of the parietal peritoneum over the intestine and uniting the flaps by a few interrupted sutures. Great care must be

taken to avoid wounding the blood vessels that lie beneath the inner flap. After reducing the hernia the neck of the sac is ligated, the stump carried upward beneath the peritoneum and finally fixed by a suture passed through the muscles. (See treatment of inguinal hernia.)

Cecopexy and Colopexy.—A majority of surgeons employ some method to fix the mobile intestine in the iliac fossa. When the internal ring is widely dilated it is sometimes possible to retract it upward and anchor the prolapsed cecum or colon satisfactorily, without having to make a second incision for this purpose. (Fig. 209.)

The method of colopexy described by Lenormant is one of the best: The point of fixation is as high as possible above the hernial opening, the distance depending on the length of the loop of colon. At this point, a flap of parietal peritoneum about 4 inches (10 cm.) long and 2 inches (5 cm.) wide

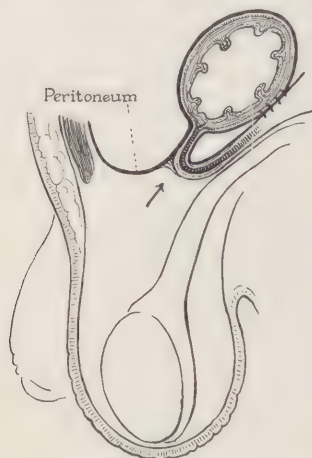


Fig. 210.—Colopexy. Mesial section to show the colon anchored in the iliac fossa.

is resected, its long axis running downward and inward. The colon with its sac attached is turned upward so that its lowest point is opposite the highest point of the denuded area. With the colon in contact with the deperitonealized surface, a suture is passed between the border of the mesentery and the inner edge of the parietal peritoneum. The free border of the colon is sutured to the outer edge of the parietal peritoneum, taking a good bite in the iliac fascia. I believe that it is sufficient to denude an area of parietal peritoneum only half as large as advised by Lenormant, for the reason that the amount of colon in a hernia compared to the amount involved in prolapse of the rectum is very small, and it is for the latter condition that his operation was originally devised. (Fig. 210.)

Lambret prolonged the hernia incision upward, opening the abdomen, and attached the folds of peritoneum that lie on each side of the intestine to the anterior lateral abdominal wall, using 5 to 6 interrupted sutures on each

side. The loop of intestine is fixed to the abdominal wall in the form of a rounded letter S. This is really a form of colopexy and a number of similar operations have been described.

Fiaschi stated that recurrences are usually due to the sliding down of the intestine and the peritoneum which formed the original hernia. He advised a colopexy of the slipped intestine. After repairing the hernia by the Bassini method, he made an incision over the iliac fossa, exposing a lozenge-shaped surface of parietal peritoneum about $1\frac{1}{2}$ inches (3.75 cm.) long. The colon is withdrawn sufficiently so that it cannot descend again into the hernia. Finally, the peritoneal attachment of the colon is fastened to the fascia and muscles of the abdominal wall by interrupted No. 1 chromic catgut sutures, and the abdominal wound is closed in the usual manner.

Morestin reconstructed the mesocolon and then performed mesoplasty. A low lateral rectus incision is made, and the base of the new mesocolon is sutured to the posterior parietal peritoneum high up in the iliac fossa or above it.

The operation devised by Savariaud is comparatively simple and can be carried out more quickly than some of the other procedures. After opening the hernial sac and identifying the contents, the intestine, sac and vessels are detached *en masse* and the edges of the sac brought over the raw area and stitched together with a running suture. The closed sac is pressed back and invaginated into the abdominal cavity, like a finger of a glove.

The Sac.—If the sac is small, I believe no attempt should be made to resect a portion of it, but the whole of it should be everted over the raw area of the intestine to form a new mesocolon; when the sac is large, the edges may be trimmed, inverted over the large intestine and sutured. The principal steps of this operation are as follows:

After freeing the sac from the cord structures, it is cautiously incised anteriorly and the opening enlarged, to expose the bowel content. The sac is divided with scissors on its posterior surface, to a point within one-half inch (1.25 cm.) of the lowest point of the intestine, almost to the lowest attachment of the mesocolon on the posterior wall. From this point the incision is continued along either side of the bowel as high up as the neck of the sac, keeping at least one-half to three-quarters of an inch (1.25 to 2 cm.) from the lateral walls of the intestine. The colon is grasped at its lowest point and pulled forward to evert the split hernial sac and turn its peritoneal surface outward, thus forming two flaps which are sutured together to cover the raw posterior surface of the intestine and to form a new mesocolon. The two edges of the divided sac are sutured together behind the bowel, which now floats free in the sac and can be reduced easily into the abdomen. The sac is inverted through the hernial ring and the opening closed. (Figs. 211, 212, and 213.)

If the intestinal loop is long, this operation has two distinct disadvan-

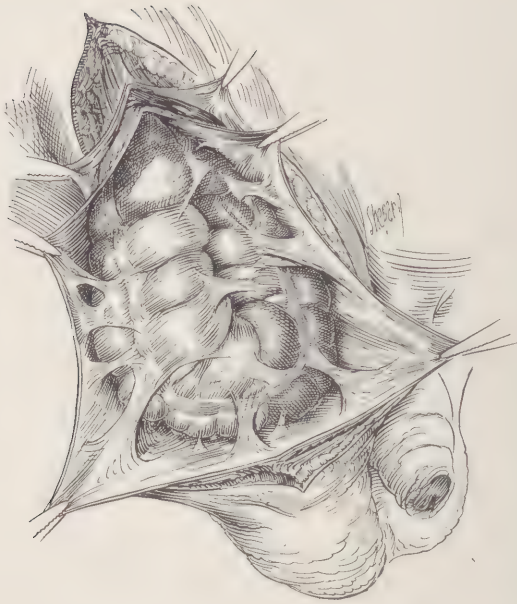


Fig. 211.—Operation for sliding hernia of the large intestine. The sac should be opened along its anterior surface because the nutrient vessels usually lie behind the intestine.

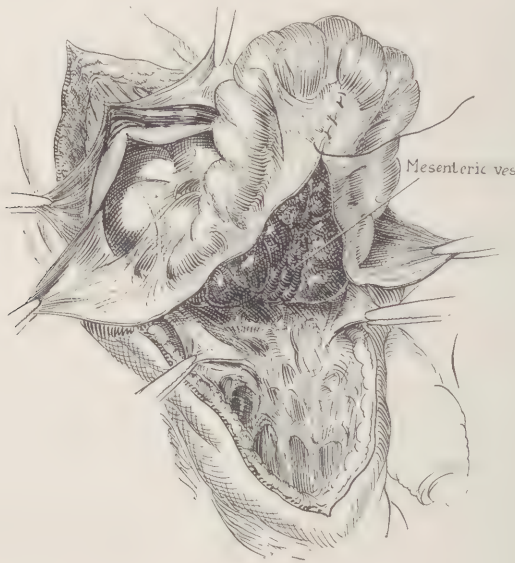


Fig. 212.—Operation for sliding hernia of the large intestine. The intestinal loop and its mesentery have been freed and the sac trimmed along either side of the bowel as high as the neck of the sac. The peritoneal edges of the trimmed sac are being sutured together behind the bowel to form a new mesocolon.

tages, namely, the danger of kinking and obstruction in the reduced intestine, and the possibility of torsion or constriction of the intestinal blood supply as it runs between the layers of the new mesocolon. For these reasons

the methods that pull up the colon and fix it to the posterior abdominal wall are to be preferred.

The Testis.—The spermatic cord and testis should never be sacrificed in order to make a complete closure of the hernial opening. If the cord cannot be isolated the sac should be left in position so as not to injure the vessels.

Closure of the Hernial Opening.—If the hernial ring is small it may be closed by Bassini's method; if it is very large, it is better to use one of the other operations I have described for large hernias in the chapters on inguinal and femoral hernia.

Operative Complications.—Operative complications in adherent hernia of the large intestine are more frequent than in simple hernia. Injury to the

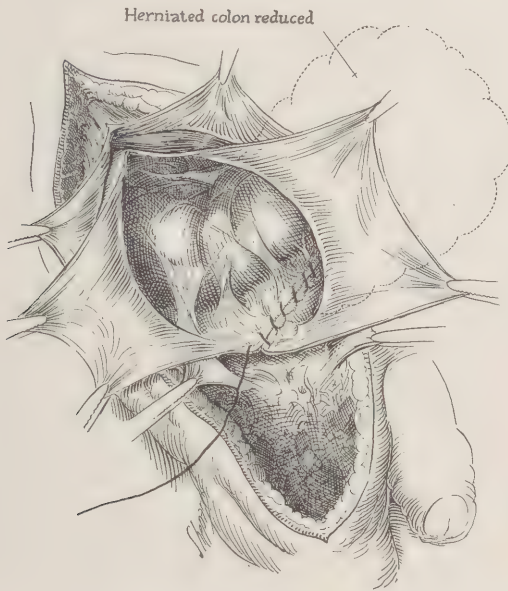


Fig. 213.—Operation for sliding hernia of the large intestine. The stitching of the new mesocolon has been completed. The two edges of the divided sac are sutured together behind the reduced bowel. The sac is inverted through the hernial ring, and the opening closed by one of the methods described under the treatment of inguinal hernia.

intestine is always serious and must be recognized immediately and taken care of. Interference with the blood supply by any of the following accidents is also to be guarded against:

1. The separation of the vessels from the intestine while attempting to dissect out the sac.
2. The inclusion of the vessels in the sutures while reconstructing the colon.
3. The inclusion of the vessels in the suture line that approximates the edges of the sac over the raw area.
4. The constriction of the vessels by the sutures of the colopexy.

Secondary hematoma in the scrotum can be prevented if all bleeding is thoroughly checked before the wound is closed.

Resection of the intestine may be required for gangrene or new growths involving the hernia. Appendicitis often occurs when the appendix is one of the hernial contents. It is always a good rule to remove the appendix after the intestine and sac have been freed. Hemorrhage following the separation of extensive adhesions or the wounding of the blood vessels of the colon in the hernia may make it impossible to complete the operation. Injury to the spermatic vessels may be followed by necrosis of the testis. In case the hernial sac is the site of suppuration, the incision should never be extended into the abdomen on account of the danger of peritonitis.

Strangulated Hernia of the Large Intestine.—Strangulated hernia of the large intestine is infrequent; the outlook is particularly grave because the subject is usually in poor health. The hernia is often very large and the treatment of strangulated adherent, immobile large intestine is much more difficult than the treatment of strangulated small intestine.

In case intestinal anastomosis by resection and suture, or by means of a Murphy button cannot be carried out, it may be necessary to make a fecal fistula and complete the operation at a later time. (See strangulated hernia under general considerations.)

Recurrence.—Recurrence after operation for hernia of the large intestine is very common because of the large hernial opening, the massive size and frequent irreducibility of the hernia, and the tendency of the colon to slip down again. (Some of the recurrences after ordinary hernia operations are due to a sliding hernia that was not recognized at the first operation.)

Recurrence is lowest when the colon is anchored to the abdominal wall by colopexy, and the hernial opening closed by one of the methods devised for very large openings. The ordinary operation for oblique inguinal hernia is insufficient. Some surgeons advise castration or placing the testis within the abdomen so as to close the opening completely. These practices are never justifiable and cannot be too strongly condemned.

Bibliography

HERNIA OF THE LARGE INTESTINE

- ANCEL, P., AND CAVAILLON, P.: L'évolution du mésentère commun chez l'homme. *J. de l'anat. et Physiol.* (etc.), Par., 1907, xliii, 389-409.
- ARNAUD, G.: *Traité des hernies ou descentes.* Paris, Le Mercier, 1749, ii, 215-229.
- BARDELEBEN, H. A.: Ueber die Lage des Blinddarms beim Menschen. *Arch. f. path. Anat.* (etc.), Berl., 1849, ii, 583-586.
- BAUMGARTNER, A.: Les hernies par glissement du gros intestin. Thèse, Paris, 1905.
- BÉRARD, A.: Hernie inguinale. *Bull. Soc. anat. de Par.*, 1827, ii, 55.
- BLEIGNY, N.: *Zodiacus Medico-Gallicus.* Geneva, L. Chouër, 1680, p. 200.
- BOYER, A.: *Traité des maladies chirurgicales.* Paris, Migneret, 1822, viii, 9-10.
- BRENNER, A.: Radicaloperationen bei Leistenhernien. *Arch. f. klin. Chir.*, Berl., 1906, lxxix, 1080-1105.
- BRUNNER, C.: *Herniologische Beobachtungen.* Beitr. z. klin. Chir., Tübing., 1888-1889, iv, 1-39.

- CAMPENON: See de Mayo, A.: Contribution à l'étude des hernies par glissement du gros intestin (hernies inguinales). Thèse, Paris, 1897.
- CARNETT, J. B.: Inguinal hernia of the cæcum. *Ann. Surg., Phila.*, 1909, xlix, 491-515.
- CHOPART, F., AND DESAULT, P. J.: *Traité des maladies chirurgicales*. Paris, Villier, 1797, ii, 218-219.
- CLOQUET, J.: *Recherches sur les causes et l'anatomie des hernies abdominales*. Thèse, Paris, 1817.
- COLEY, W. B.: *Hernia*. *Progr. Med., Phila., Lea & Febiger*, 1910, ii, 64-66.
- CRILEY, C. H.: Parasacculor or sliding hernia. *Surg. Gynec. & Obst., Chi.*, 1920, xxxi, 611-616.
- CRUVELHIER, J.: *Traité d'anatomie descriptive*. 3rd ed., Paris, Labé, 1852, iii, 348-351.
- DAVID, V. C.: Sliding hernias of cecum and appendix in children. *Ann. Surg., Phila.*, 1923, lxxvii, 438-444.
- DURET, H.: Des variétés rares de la hernie inguinale. Thèse de concours, Paris, 1885.
- EHLER, F.: (Radical treatment of hernia containing the colon). *Casop. lék. česk., v. Praze*, 1914, liii, 475-480.
- ERB, K. K.: Der Processus vermiformis als linksseitiger Hernien. *Deutsche Ztschr. f. Chir., Leipz.*, 1922, clxxvi, 379-398.
- ESTOR, E.: La hernie étranglée chez le nourrisson. *Rev. de chir., Par.*, 1902, xxv, 249-293; 442-454; 721-745.
- FIASCHI, T.: The radical treatment of sliding hernia. *Australas. M. Gaz. Sydney*, 1907, xxvi, 578-580.
- FINSTNER, H.: Zur Kenntnis der Gleitbrüche des Dickdarmes. *Beitr. z. klin. Chir., Tübing.*, 1912, lxxxi, 198-239.
- FOERSTER, O. H.: Statistical study of fifty-three cases of left cecal hernia, with report of an additional case. *Univ. Penn. M. Bull., Phila.*, 1901-1902, xiv, 358-363.
- GALEN, C.: See Geiger, M.: p. 11.
- GEIGER, M.: *Kelegraphia sive descriptio herniarum cum eorundem curationibus tam medicis quam chirurgicis*. Monachii, N. Henricum, 1631.
- GIBBON, J. H.: Cecal hernia with a classification of sixty-three cases. *J. Am. M. Assn., Chi.*, 1898, xxx, 1385-1388.
- GOSSELIN, L.: *Leçons sur les hernies abdominales*. Paris, A. Delahaye, 1865.
- HARTMANN, H.: Anomalie dans la situation du cæcum. *Bull. Soc. anat. de Par.*, 1887, lxii, 311-312.
- HESELBACH, F. C.: *Disquisitiones anatomico-pathologicae de ortu et progressu herniarum inguinalium et cruralium*. Wireeburgi, Staheliano, 1816.
- HILDEBRAND: Die Lageverhältnisse des Cöcum und ihre Beziehung zur Entstehung von äusseren Cöcalbrüchen. *Deutsche Ztschr. f. Chir., Leipz.*, 1891-1892, xxxiii, 182-213.
- HILGENREINER, H.: Seltene und bemerkenswerte Hernien. *Beitz. z. klin. Chir., Tübing.*, 1910, lix, 333-430.
- HOTCHKISS, L. W.: Large sliding hernia of the sigmoid. *Ann. Surg., Phila.*, 1909, l, 470-473.
- HUNTINGTON, G. S.: *The anatomy of the human peritoneum*. Phila., Lea Bros., 1903.
- JABOULAY, M., AND PATEL, M.: *Hernies*. XXV *Nouveau traité de chirurgie*. Le Dentu, A. et Delbet, P., Paris, Baillière, 1908.
- JONNESCO, T.: In: *Traité d'anatomie humaine*. Poirier, P. et Charpy, A., Paris, Masson, 2nd ed., 1901, iv, 337.
- KIRCHNER, W. C. G.: The treatment of sliding hernia. *Am. J. Obst., N. Y.*, 1911, lxiv, 758-768.
- LABAT, G.: Cure radicale de la hernie du colon "par glissement." *Presse méd., Par.*, 1919, xxvii, 182-184.
- LAMBRET: See Mouton, G. H.: Des hernies adhérentes par glissement du gros intestin; leur thérapeutique. Thèse, Lille, 1899.
- LARDENNOIS, G., AND OKINCZYK, J.: *Étude sur les hernies du gros intestin*. Paris, Masson, 1910.
- LEGUEU, F.: La situation du cæcum chez l'enfant. *Bull. Soc. anat. de Par.*, 1892, vi, 55-69.
- LENORMANT, C.: La colopexie; contribution l'étude thérapeutique du prolapsus du rectum. *Rev. de chir., Par.*, 1907, xxxv, 191-246; 443-470.
- LESSHAFT, P.: Die Lumbalgegend in anatomisch-chirurgischer Hinsicht. *Archiv. f. Anat. u. Physiol. u. Wissensch. Med., Leipz.*, 1870, p. 264-299.
- LOCKWOOD, C. B.: On abnormalities of the cæcum and colon with reference to development. *Brit. M. J., Lond.*, 1882, ii, 574-577.
- LUSCHKA, H.: Ueber die peritoneal Umhüllung des Blinddarmes und über die Fossa iliocœcalis. *Arch. f. path. Anat. (etc.)*, Berl., 1861, xxi, 285-288.

- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- MALGAIGNE, J. F.: Leçons cliniques sur les hernies. Paris, Germer-Baillière, 1841.
- MARCHETTI, G.: Sopra un caso di ernia ischiatica contenente un ampio diverticolo sigmoideo formatasi da causa mai ancora notata. *Polielin.*, Roma, 1919, xxvi, sez. chir., 244-248.
- MECKEL, J. F.: Handbuch der Menschlichen Anatomie. Halle u. Berl., 1820, iv, 667-677.
- MECKEL, J. F.: See Macready, J. F. C. H.: p. 102.
- MORESTIN, H.: Hernies par glissement de l'Siliaque et de l'iléon. *Bull. et mém. Soc. de chir. de Par.*, 1910, n. s., xxxvi, 709-714.
- OTTO, J.: See Koch: Die Entwicklungsgeschichte der Dickdarmbrüche. I. D., Leipz., 1899.
- PELLETAN, P. J.: Clinique chirurgicale. Paris, J. G. Dentu, 1810, iii, 345-348.
- PETIT, J. L.: Oeuvres complètes. Limoges, F. Chapouland, 1837, p. 608-682.
- PETROVIC, M.: (Results of inguinal herniotomies performed during the last nine years in the Moravian Military Hospital with special reference to Bassini's and Kocher's method.) *Srpski arh. za celok. lek.*, Beograd, 1908, xiv, 105-115.
- RANSOHOFF, J. L.: Adherent hernias of the large intestine. *Ann. Surg., Phila.*, 1912, lvi, 313-327.
- RENAULT, P.: Les hernies inguinales du cæcum et de l'Siliaque considérées principalement chez l'enfant. Thèse, Paris, 1898.
- RICHARDS, O.: Notes on two cases in which the appendix was present in a hernial sac on the left side. *Lancet*, Lond., 1909, i, 1386.
- ROBINSON, H. B.: Hernia of the ilio-pelvic colon. *Lancet*, Lond., 1909, i, 599-601.
- ROCHARD, E.: Les hernies. Paris, O. Doin, 1904.
- ROUSSETUS, F.: *Caesarei Partus*, Paris, 1590, p. 208-211.
- ROYER, D. J.: An unusual case of temporary incarceration of transverse colon within bilateral hernial sacs. *J. Indiana M. Assn.*, Fort Wayne, 1920, xiii, 227-228.
- SANDIFORT, E.: *Observations anatomico-pathologicae*. Lugduni, Eyk et Vygh, 1777, i, 65-77.
- SAVARIAUD: Hernie par glissement de l'Siliaque. Procédé nouveau de cure radicale. *Bull. et mém. Soc. anat. de Paris*, 1900, 6 s., ii, 772-777.
- SCARPA, A.: Sull'ernia, *memorie anatomico-chirurgiche*. 2nd ed., Pavia, Dalla stamperia Fusi e co., success. Galeazzi, 1819.
- SCHULZ, F. C.: Ueber Gleitbrüche und über grosse Leistenhernien. *Arch. f. klin. Chir.*, Berl., 1912, xcviii, 324-354.
- SERNIN: See Lardennois, G., et Okinczye, J.: p. 2.
- SPIGELIUS, A.: *Opera quæ extant omnia*. Amstelodami, J. Blaev, 1645, p. 216-219.
- SPRENGEL: Erfahrungen über den Gleitbruch des Dickdarms. *Arch. f. klin. Chir.*, Leipz., 1911, xcv, 702-737.
- SYMINGTON, J.: The relations of the peritoneum to the descending colon in the human subject. *J. Anat. & Physiol.*, Lond., 1891-1892, xxvi, 530-537.
- TENAIN, J.: Des organes que l'on rencontre dans les hernies inguinales. *Ann. de chir. fr. et étr.*, Par., 1842, iv, 156-177.
- THURSTON, E. O.: Some surgical cases. *Indian Med. Gaz.*, Calcutta, 1911, xlv, 423-425.
- TOLDT, K.: See Lardennois, G., et Okinczye, J.: p. 16.
- TREVES, F.: Hernia of the cæcum. *Brit. M. J.*, Lond., 1887, i, 382-385.
- TRITSCHLER, F. W. G.: Diss. sistens observationes in hernias præcipue intestini cæci. I. D., Tübing., 1806.
- TUFFIER, T.: Étude sur le cæcum et ses hernies. *Arch. gén. de méd.*, Par., 1887, xx, 52-65.
- WALTON, A. J.: Extrasaccular hernia. *Ann. Surg., Phila.*, 1913, lvii, 86-105.
- WEIR, R. F.: On the treatment of the sliding hernias of the cæcum and sigmoid flexure. *Med. Rec. N. Y.*, 1900, lvii, 309-313.
- WRISBERG, H. A.: Observationes anatomicae de testiculorum ex abdomine in serotum descensu. *Gottingæ, J. C. Dieterich*, 1779, p. 52.

CHAPTER XXIV

HERNIA OF THE VERMIFORM APPENDIX

Synonyms.—Appendicocoele; Appendical hernia.

Definition.—Hernia of the vermiform appendix is a protrusion of the appendix through a normal or abnormal opening in the abdomen or pelvis.

Appendical hernia is not common, being about as frequent as bladder hernia. Both of these varieties are most often found in subjects past middle life, and the appendix is usually accompanied by the cecum, omentum, or small intestine. On the other hand, isolated hernia of the appendix is found most frequently in infants under two years of age. (Hernia of the appendix is sometimes found in the internal fossae, usually in the pericecal fossa; this variety of appendical hernia is considered in the chapter on internal hernia.)

Ceco-appendical hernias, which include those cases where the principal symptoms are referred to the cecum, and the appendix merely accompanies the latter into the sac, are discussed in the chapter on hernia of the large intestine.

Historical

The appendix was first distinguished by Berengerius Carpus in 1524, described by Vesalius in 1543, and by Fallopius in 1560. In 1561 Vidus Vidius gave it the name of appendix vermiformis.

De Garengéot, in 1731, was the first to describe the appendix as a content of a hernial sac. The next case was reported by Amyand in 1736, and another by Morgagni in 1761; and in 1785 Hévin described in detail an operation for purulent appendicitis in the sac of a femoral hernia. Other cases were reported by Tritschler, in 1806, Hesselbach, in 1814, Taramelli, in 1835, Javanelli, in 1836, and a number of other early writers.

Merling, in 1836, described a strangulated appendical hernia that was successfully operated on by Tiedmann. Charyau, in 1837, and Cabaret, in 1842, also reported instances in which they had operated for hernia of the appendix. During this early period operation was undertaken only when an abscess had formed, and then the procedure consisted of simple incision and drainage.

From the middle of the 19th century, the operation was resorted to with increasing frequency, and with the advent of antiseptics it was undertaken earlier, but unless the appendix was gangrenous, it was reduced into the abdominal cavity. It was not until near the close of the last century that the removal of the appendix became a routine procedure.

Important papers on this subject have been published by Pollosson, Thiéry, Charnois, Rivet, Bariéty, Briançon, Taillefer, Osty, Naquet, Honoré;

Vésignié, Levy, Jacquemin, Le Duigou, Wood, Clogg, De Garmo, Gray, Girolamo, Niedlich, and others.

In 1923 I collected from the literature 512 cases of hernia of the appendix alone. Of these 269 were inguinal, 217 femoral, and 2 obturator. In 24 the site of the hernia was not stated.

INGUINAL HERNIA OF THE APPENDIX

Age.—In 252 cases the age of the patient was given:

Under 2 years	40 cases
2 to 10 years	47 cases
11 to 20 years	19 cases
21 to 30 years	20 cases
31 to 40 years	11 cases
41 to 50 years	31 cases
51 to 60 years	50 cases
61 to 70 years	22 cases
71 to 80 years	10 cases
81 to 90 years	2 cases
	<hr/> 252 cases

Duration of the Hernia.—The duration of the hernia was given in 102 cases:

41 to 50 years	2 cases
31 to 40 years	4 cases
21 to 30 years	7 cases
11 to 20 years	9 cases
1 to 10 years	21 cases
1 to 11 months	3 cases
Less than 1 month	2 cases
Less than 1 day	2 cases
Congenital	52 cases
	<hr/> 102 cases

Sex.—The sex was given in 242 cases.

Males	218
Females	24
	<hr/> 242

Side Involved.—The side involved was stated in 249 cases:

Right	230
Left	19
	<hr/> 249

Duration of Acute Symptoms.—The duration of acute symptoms before operation; or before abscess formation or before time of death in nonoperative cases:

1 to 4 weeks	18 cases
6 days	1 case
5 days	4 cases
4 days	4 cases
3 days	13 cases
2 days	9 cases
1 day	15 cases
12 hours	2 cases

In 30 cases it was stated that the appendix was entirely in the sac. In 13 cases the hernia of the appendix was found at autopsy. In 14 cases the appendix was adherent to the testicle, and in 3 cases it was adherent to the cord. In 2 cases the appendix was cystic; and in 7 patients the condition was diagnosed before operation.

Length of Appendix.—The length of the appendix was given in 38 cases. In these the average length was 3 inches (7.5 cm.); in 15 the appendix was 4 inches (10 cm.) long or longer.

Treatment

	NO. CASES	RECOVERIES	DEATHS
Appendix excised	140	135	5
Appendix reduced	17	15	2
Appendix operation	38	37	1
Abscess drained	26	20	6

Of the patients treated by taxis, 2 died of peritonitis. In 2 the hernia was reduced *en masse*; one of these patients was operated upon and recovered, and the other one developed peritonitis and a fecal fistula formed.

FEMORAL HERNIA OF THE APPENDIX

Age.—In 175 of the 217 cases of femoral hernia of the appendix alone, the age of the patient was given:

Under 2 years	0 cases
2 to 5 years	5 cases
11 to 20 years	1 case
21 to 30 years	8 cases
31 to 40 years	16 cases
41 to 50 years	45 cases
51 to 60 years	36 cases
61 to 70 years	43 cases
71 to 80 years	18 cases
81 to 90 years	3 cases
	175 cases

Duration of the Hernia.—The duration of the hernia was given in 50 cases:

41 to 50 years	1 case
31 to 40 years	1 case
21 to 30 years	1 case
	9 cases
6 to 10 years	8 cases
1 to 5 years	21 cases
1 to 11 months	2 cases
1 to 2 weeks	2 cases
Less than one day	3 cases
Congenital	2 cases
	50 cases

Sex.—In 181 cases the sex was given:

177 females
4 males
<hr/> 181

Side Involved.—In 164 cases the location of the hernia was stated; 161 were on the right side and 3 on the left.

Duration of Acute Symptoms.—The duration of acute symptoms of appendicitis was given in 113 cases:

6 months	1 case
5 months	1 case
3 to 4 weeks	5 cases
1 to 2 weeks	22 cases
6 days	1 case
5 days	8 cases
4 days	9 cases
3 days	16 cases
2 days	18 cases
1 day	12 cases
12 hours	10 cases
Less than 12 hours	10 cases
	<hr/> 113 cases

Simultaneous Appearance of Hernia and Appendicitis.—In 16 cases the symptoms of appendicitis were present when the hernia first appeared:

5 months	1 case
2 weeks	4 cases
9 days	2 cases
8 days	2 cases
5 days	2 cases
3 days	3 cases
2 days	1 case
1 day	1 case
	<hr/> 16 cases

In 25 cases the entire appendix was in the sac. In 3 cases the femoral hernia of the appendix was discovered at autopsy. In 3 cases the appendical hernia was diagnosed before operation. In 2 cases there was retrograde strangulation of the appendix. In one a hernial abscess was due to perforation of the appendix by a pin.

Length of the Appendix.—The length of the appendix was given in 38 cases, and the average length of the portion in the sac was 3 inches (7.5 cm.). In two cases the appendix was 12 inches (30 cm.) long.

Treatment

The method of treatment employed and the result was stated in 174 cases:

	NO. CASES	RECOVERIES	DEATHS
Appendix excised	129	124	5
Appendix reduced	23	21	2
Abscess drained, fecal fistula	22	13	9

In one patient who recovered without operation, a portion of the appendix $3\frac{1}{4}$ inches (8 cm.) long was cast off by the bowel.

OBTURATOR HERNIA OF THE ISOLATED APPENDIX

I have found in the literature 2 cases of obturator hernia of the isolated appendix:

CASE I.—Female, aged thirty-four, right obturator appendical hernia. Acute symptoms 3 days. Abscess drained spontaneously through the femoral canal. Recovery.

CASE II.—Female, aged forty-two, with a painful mass, which later became fluctuating in obturator region. Operation refused. At autopsy an abscess was found and the appendix was in the obturator canal and perforated.

Anatomy

The appendix may be alone in the hernial sac, or it may accompany the cecum or other viscera into the sac. A number of cases of congenital inguinal hernia are on record in which the appendix was found adherent, usually at

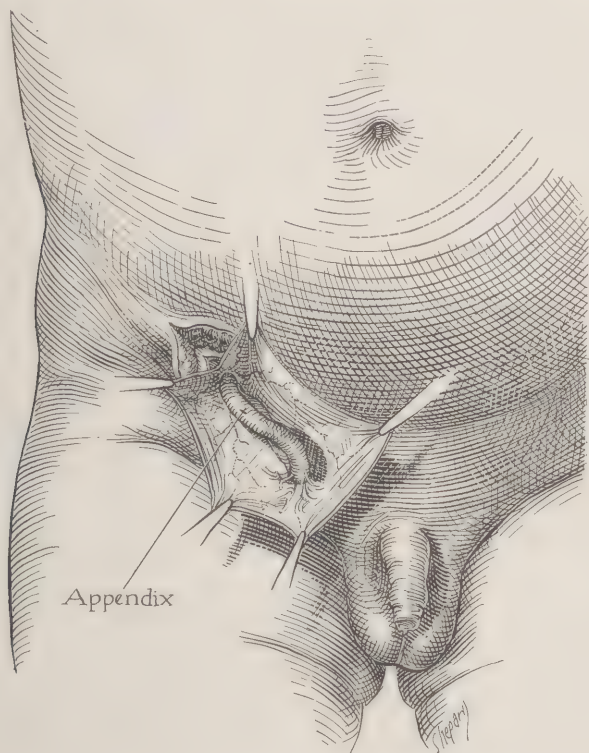


Fig. 214.—Inguinal hernia of the isolated appendix. Note the adhesions between the tip of the appendix and the fundus of the sac.

its tip to the testis. The appendix may enter any of the hernial openings, and for anatomic reasons, it is nearly always found on the right side. Left-sided hernia of the appendix is very rare. Sometimes the appendix remains in the sac for a long time without causing symptoms, especially if it is associated with other viscera. (Fig. 214.)

Diagnosis is seldom made before operation, the condition usually being

discovered during an operation for hernia. Appendicitis in the hernial sac is almost always mistaken for strangulated omental hernia accompanied by appendicitis. When the appendix is the sole content of the sac, the hernia is usually small and gives no symptoms until the appendix becomes inflamed and adherent to the sac wall. In reducible hernia, appendical hernia is seldom diagnosed because the operator nearly always reduces the contents into the abdomen before the sac is opened.

Frequency.—A review of the literature shows that the appendix is present in 1 to 1.5 per cent of all hernias containing abdominal viscera. It is found in about 1 per cent of hernias in subjects between 30 and 50 years of age, and in about 1.5 per cent of those past 50. The appendix is nearly always accompanied by the cecum. Hernia of the isolated appendix is comparatively rare, occurring about 3 times in 1,000 hernias.

FREQUENCY OF THE APPENDIX IN A HERNIAL SAC, ALONE OR ACCOMPANYING INTESTINE

	TOTAL CASES HERNIA	NO. APPENDIX HERNIAS	PER CENT
Wassiljew	106	4	3.7
Staatsmann	602	28	4.6
Clogg	3,440	65	1.9
	100 children	8	8
Verebély	1,000	18	1.8
Hilgenreiner	2,230	25	1.1
Fantino	4,580	18	0.4
Gussew	420	3	0.7
Cluss	161	7	4.5
Hofman	250 femoral	9	3.6
Total	12,889	185	1.43

FREQUENCY OF HERNIA OF THE APPENDIX ALONE

	TOTAL CASES HERNIA	HERNIA OF THE APPENDIX ALONE	PER CENT
Jaia	1,586	27	1.7
Weyprecht	402	6	1.9
Wassiljew	106	1	0.9
Verebély	1,000	1	0.1
Girolamo	6,756	4	0.059
Cocuzza	1,500	1	0.05
Desmosthen	1,642	8	0.48
Fantino	4,200	5	0.119
Total	17,192	53	0.308

In 3,000 autopsies at the Massachusetts General Hospital, Magruder found the appendix alone in a hernial sac 4 times.

VARIETIES OF HERNIA OF THE APPENDIX

The varieties of hernia of the appendix in the order of their frequency are: Inguinal, femoral, umbilical, diaphragmatic, ventral, obturator, perineal, and sciatic. It is possible for the appendix to make its exit through other openings, but such instances have never been reported.

A. **Inguinal.**—Inguinal hernia of the appendix is by far the most common form, about 55 per cent of the recorded cases being of this variety. This is due to the proximity of the appendix to the internal inguinal ring, and to the fact that the inguinal ring is many times larger than the femoral ring.

B. **Femoral.**—The femoral variety constitutes about 40 per cent of all cases, being much less frequent than the inguinal variety. The femoral ring is situated only a short distance below the internal inguinal ring. Appendical femoral hernia would be more common than the inguinal variety because of the lower position of the femoral ring and the tendency of the cecum and appendix to gravitate downward, were it not for the fact that the femoral opening is not as constant as the inguinal opening, and when it does exist it is very much smaller than the inguinal ring. Because appendicitis of the isolated appendix is more frequent in femoral than in inguinal hernia, some writers have maintained that femoral hernia of the appendix is the more frequent variety. Statistics do not support this claim. Femoral hernia of the appendix nearly always occurs in women (98 per cent); it is very rare in men (2 per cent).

C. **Umbilical.**—Umbilical hernia of the appendix is rare, constituting only about 4 per cent of all appendical hernias. The appendix has never been found alone in an umbilical hernia. In the few recorded cases it has been accompanied by other viscera such as, cecum, colon, omentum, and small intestine.

D. **Ventral.**—Ventral hernia of the appendix is very rare. It has been found in small hernias in the appendix region. In massive eventrations, involving most of the abdominal viscera, the appendix accompanies the cecum.

E. **Diaphragmatic.**—Diaphragmatic hernia of the appendix is always accompanied by other viscera, such as cecum, transverse colon, stomach, small intestine, and omentum. (See chapter on diaphragmatic hernia.)

F. **Obturator.**—Obturator hernia of the isolated appendix is very rare. In 512 hernias of the appendix alone which I collected from the literature, there were only 2 cases of isolated appendical obturator hernia (0.4 per cent).

Pathology of the Appendix

The earliest recorded cases of appendical hernia were found at autopsy, or discovered after the incision of a hernial abscess, or during operation for strangulated hernia. It should be borne in mind that the herniated appendix is liable to all the lesions of the intraabdominal appendix.

The Appendix Vessels.—The single artery supplying the appendix and its accompanying veins are subject to pressure from traction or kinking of the appendix. After infection occurs the vessels are frequently obstructed by septic thrombi. In women a second artery is sometimes found in the peritoneal fold joining the broad ligament and appendix.

A. The Noninflamed Appendix.—The noninflamed appendix in a hernial sac is seldom diagnosed before operation. When the appendix is accompanied by the cecum or other viscera, it is usually healthy or only slightly diseased, because the hernial rings are necessarily large and the presence of the other viscera protect the appendix from pressure from the hernial ring, and adhesions to the sac wall do not form as often or as early as in isolated appendical hernia.

When the appendix is alone in the sac, the hernial ring is small and constriction sometimes occurs. In 95 per cent of the cases of hernia of the isolated appendix, the appendix is adherent to the sac wall. Adhesions are more constant in this variety of hernia than in any other. The presence of adhesions and a narrow ring favor the early development of inflammation and infection. These complications are more frequent in femoral hernia, on account of the small femoral ring and the pressure and trauma produced by the movement of the thigh, than in inguinal hernia. Appendices in hernial sacs may be of normal length, 4 to 5 inches (10 to 12.5 cm.) but more often they are thickened and elongated, sometimes attaining a length of 8 to 12 inches (20 to 30 cm.). Fromme reported a case in which the appendix was $3\frac{1}{2}$ inches (8 cm.) long and $4\frac{1}{2}$ inches (12 cm.) wide.

If there are other viscera in the sac the appendix is usually adherent to them as well as to the sac wall. The appendix may be curled or kinked on itself. When there is obstruction in the lumen near the base of the appendix, the distal portion may be the site of cystic distention, due to an accumulation of the secretion from Lieberkühn's follicles, as in the cases reported by Van Hook, Wölfler, and Anderegg. Hutchinson stated that when the cystic appendix is intraabdominal, it may attain a diameter of 4 inches (10 cm.) or more and closely resemble small intestine or a Meckel's diverticulum. It may contain several ounces of mucoid fluid.

When hernia of the isolated appendix occurs in subjects with enlarged hernial rings and relaxed abdominal walls, it usually drags the cecum into the sac in a short time.

B. Appendicitis in the Hernial Sac.—When the appendix is in the hernial sac, it is more commonly subject to acute and chronic inflammation than when it remains in the abdomen.

Strangulation and Inflammation.—Strangulated appendical hernia is very rare. The term is often incorrectly applied to ordinary hernial appendicitis, and this has led to much confusion. Appendicitis in the hernial sac has often been diagnosed as strangulated hernia, simply because the mass was irreducible and gangrenous, while in reality the same changes in an intraabdominal appendix would have been ascribed to inflammation and infection. I believe that most of the reported cases of "strangulation" of the appendix are in reality hernial appendicitis.

Partial strangulation, which is very frequently the first stage of hernial

appendicitis, is favored by the following factors: The dependent position of the appendix; the obstruction to the blood supply of the appendix, due to the weight of the cecum or other overlying viscera; the occasional pressure exerted by the edge of the hernial ring; and rarely, the presence of a fecal concretion or foreign body in the lumen of the appendix. The swelling, edema and congestion of the first stage, together with the increasing circulatory obstruction, lower the resistance of the appendix and provide the setting for the second stage, which consists of infection, followed by inflammation that terminates, as a rule in gangrene and perforation.

FREQUENCY OF ABDOMINAL AND HERNIAL APPENDICITIS

	TOTAL CASES APPENDICITIS	NO. IN HERNIAL SAC	PER CENT
Sonnenburg	4,000	8	0.2
Hofman	4,000	2	0.05
Fromme	692	1	0.14

C. Strangulated Appendical Hernia.—When the cecum or other viscera are strangulated with the appendix, the changes in the appendix seldom proceed beyond the first stage of edema and congestion. Complete strangulation of the appendix is rare, and almost always occurs when the appendix is the sole content of the sac. Nearly all of the recorded cases have been in femoral hernias. In strangulated appendical hernia the sac usually contains fluid, which is clear, turbid or blood-tinged. The appendix is dark in color, sometimes dusky or purple and if gangrenous it may have a dead-leaf hue, the same as strangulated intestine. The thick lymph associated with inflammation is absent and adhesions are not extensive. The point of constriction can usually be seen at the base of the appendix, or on the lower part of the cecum just beyond the ceco-appendical junction. After the constriction is divided, a groove or furrow can often be seen at the point of strangulation and the appendix quickly assumes its normal color, just as other strangulated intestine does, providing gangrene has not set in.

D. Apoplexy of the Appendix.—The term “apoplexy of the appendix” was proposed by Pascal and Pilliet to describe a partial strangulation of the appendix. The condition is characterized by an engorgement and thrombosis of the blood vessels, and diffuse hemorrhages in the appendix and meso-appendix.

Point of Constriction in Strangulation.—The usual point of constriction is the rigid boundary of the hernial ring, especially the sharp edge of Gimbernat's ligament in femoral hernia. Sometimes the constriction is due to an omental band which is adherent to the sac wall; or to the neck of the sac being very narrow; or to a constriction in the sac itself.

The Mesoappendix.—When the mesoappendix accompanies the appendix into the hernial sac it soon becomes adherent to the sac wall or to the other contents. It is usually thickened, elongated and contains an excessive amount

of fat, which increases the danger of strangulation by pressure on the appendix. When the mesoappendix is strangulated it has the appearance of intense venous congestion, resembling strangulated omental hernia.

Obstruction and incarceration are much more frequent in femoral appendical hernia than in the inguinal variety.

The Sac.—The sac of an appendical hernia may be complete, or it may be incomplete when some of its coverings are lacking. The appendix may be retroperitoneal, lying entirely outside of the sac, as in a sliding hernia of the large intestine. The sac may be single or multilocular. In isolated hernia of the appendix it is sometimes thickened at a point opposite the tip of the appendix. Dujarier and Castaigne found a bilocular sac in a right inguinal hernia in a woman; one locus was empty and the other contained the appendix which was nodulated, and could be distinctly felt before the sac was opened.

Amount of Appendix in the Sac

A. Complete.—The entire appendix is usually found in the sac of cecal hernias. Factors that favor the complete descent of the appendix are: An abnormally mobile cecum; a long mesoappendix; the absence of adhesions in the neck of the sac; and adhesion of the tip of the appendix to the testis, or to the fundus of the sac in complete hernia.

B. Incomplete.—In a majority of the cases of hernia of the isolated appendix only one-half to two-thirds of the appendix lies in the sac. Incomplete hernias are usually caused by adhesions of the appendix to the neck of the sac, a short mesoappendix, an immobile cecum, and traction exerted on the appendix by the cecum. When the mobility of the cecum permits it to travel to the left side to a point opposite the left internal inguinal or femoral rings, it is an easy matter for the appendix to descend into a preformed sac. In left-sided appendical hernias, the appendix is nearly always abnormally long, while in right-sided ones, it is usually normal in length.

Localized Peritonitis.—Because of the isolated position of the inflamed appendix, extensive adhesions usually form early and confine the infection to the sac, thus preventing the peritonitis from invading the abdominal cavity. For this reason the prognosis in hernial appendicitis is more favorable than in the abdominal variety.

Retrograde Strangulation.—Retrograde strangulation sometimes occurs, usually when the appendix is abnormally long. The central portion of the appendix is caught in the hernial ring, while the tip and the base remain in the abdomen. The pressure at two points obstructs the blood supply and gangrene and perforation of the proximal end may develop rapidly.

Etiology

Appendical hernias are most conveniently considered by dividing them into two groups, congenital and acquired:

1. **Congenital.**—Congenital hernias of the appendix are those in which the appendix is in the hernial sac at birth. The cecum usually has a long mesentery; it is freely movable and almost always accompanies the appendix into the sac. Scarpa believed that the appendix is drawn down by the descent of the testis or ovary to which it is adherent. Lockwood stated that the gubernaculum testis is sometimes attached to the cecum and appendix, and suggested this as a possible cause of hernia of these viscera. These theories are not generally accepted at the present time. It is probable that isolated appendical hernia descends into a preformed sac, as other intestinal hernias do, or that it is drawn into it by the cecum; or a lax mesocecum favors the development of a mesocolon, thus increasing the range of movement of the cecum and appendix.

2. **Acquired.**—Acquired hernias of the appendix are those in which the appendix enters a preformed or congenital sac after birth.

Exciting Causes.—The exciting causes of appendical hernia are the same as those that apply to other intestinal hernias, such as trauma, strain, lifting, coughing, whooping cough, and anything that increases intraabdominal tension. When the cecum enters the sac first, the hernia of the appendix is usually due to a long-continued intraabdominal tension associated with a slipping of the parietal peritoneum, such as occurs in sliding hernia.

Predisposing Causes.—The predisposing causes of hernia of the appendix are: Abnormal mobility of the cecum; elongation of the mesentery and sometimes of the appendix; general ptosis of the abdominal viscera and relaxation of the abdominal wall; and traction exerted on the appendix by the cecum or adherent viscera already in the sac.

Age and Sex.—Isolated inguinal hernia of the appendix is found most frequently in subjects under ten years of age. Hernia of the appendix and cecum is found most often in the middle-aged or elderly, increasing in frequency as age advances. Femoral hernia of the appendix is most frequent between the 40th and 70th years. Inguinal hernia of the appendix nearly always occurs in males, and femoral appendical hernia in females.

Left Appendical Hernias.—Hernias of the appendix on the left side are very rare. When they are found in the newly born, they are nearly always due to developmental anomalies, and the cecum and ascending colon are usually found occupying the left side of the abdomen. In older subjects they may be accounted for by one or more of the following factors: Ptosis of the cecum; a mesentery so long that a large hernia containing ileum may, by traction, draw the cecum and appendix to the left side; scoliosis and kyphosis. Transposition of viscera is rarely a cause of left-sided appendical hernias in adults.

Appendicitis in the Hernial Sac.—The same factors that are responsible for abdominal appendicitis are also the cause of hernial appendicitis. When the appendix enters the hernial sac it is subjected to more trauma and cir-

culatory disturbances than when it remains in the abdomen, consequently it often becomes inflamed, its walls thicken, and it becomes adherent to the sac wall or to other viscera. In inguinal hernia the exposed position of the appendix and the contractions of the abdominal muscles are responsible for considerable irritation and trauma to the appendix. In femoral hernia, the narrowness of the hernial opening, the pressure exerted by the sharp edge of Gimbernat's ligament, and the trauma due to active movements of the thigh are responsible for the early development of appendicitis in a majority of femoral appendical hernias. The danger of strangulation of the isolated appendix is increased when the mesoappendix is thick and contains large lobules of fat.

Symptoms

Hernias that contain only the appendix are small and easily reducible in the early stages, and cause few symptoms or none. Often they remain reduced most of the time, appearing only after some unusual strain or when the truss has been left off. Sometimes reduction of the hernia causes pain, and there may be a history of attacks of irreducibility and partial strangulation, accompanied by symptoms of appendicitis. In rare instances an appendical hernia will strangulate the first or second time it comes down. Hernia of the appendix is comparatively frequent in infants and children, and with these little patients it is sometimes possible to palpate the appendix in the sac. As a rule, the symptoms give rise to considerable pain and discomfort. Macewen saw a case in an infant 6 months old, whose mother stated that the swelling was the size of a marble when first noticed; it became more difficult to reduce as it increased in size, and the baby grew correspondingly cross and irritable until relieved by operation.

Functional Symptoms.—As long as the hernia is easily reducible or can be retained by a truss, the patient is usually free from symptoms. As adhesions form between the appendix and the sac wall, he notices increasing pain and discomfort referred to the appendix region in the right hypogastrium, sometimes extending to the umbilicus or to the lower border of the ribs. Because of the small size of the hernia, the symptoms are usually referred to the appendix, and the possibility of a hernial appendicitis is generally overlooked. A correct diagnosis was made before operation in less than 1 per cent of the cases reported in the literature.

In acute hernial appendicitis, other symptoms in addition to pain are: Distention of the abdomen with some tenderness, but without rigidity of the abdominal muscles such as is found in abdominal appendicitis; malaise, fever, constipation and disturbances in micturition. Flatus and feces continue to pass as obstruction does not occur unless small intestine, cecum or colon is strangulated by the hernial ring. Sometimes there is pain referred to the scrotum in inguinal appendicitis; in the femoral variety the pain may be

referred to the hip-joint and down the inner side of the thigh as far as the knee. Movement of the thigh on the affected side is limited and often accompanied by considerable pain. In rare instances, there is a dragging pain referred to the right iliac fossa.

Both strangulation and inflammation are commonly ushered in with an acute onset. Nausea and vomiting may occur with both, especially at the beginning. The abdominal pain is colicky, localized or general. The symptoms are those of partial strangulation and the condition is often diagnosed as a strangulated omental or Richter's hernia. When the appendix is strangulated the temperature is subnormal and does not become elevated until after the onset of infection and inflammation.

In hernial appendicitis the temperature is not as high as in abdominal appendicitis, on account of the localization of the infection within the sac, which is due to the early closure of the hernial opening by the inflammatory adhesions. Hence operation is usually delayed until after gangrene has developed. Shock and collapse are not marked except in children.

Objective Signs.—The signs of a noninflamed appendix in the hernial sac are almost always vague and indefinite. In the beginning the hernia is small and easily reducible; as adhesions form in the sac, it becomes tender and painful, and more difficult to reduce. There is usually a history of occasional attacks of appendicitis, with the local symptoms referred to the hernia, which is temporarily irreducible.

In many instances the hernia comes down for the first time during an acute attack of appendicitis and is immediately irreducible. If the appendix is alone in the sac and not adherent to the wall, reduction is not accompanied by a gurgling sound, and there is no impulse on coughing. When the cecum, colon or small intestine are also in the sac, the hernia is usually large, resonant on percussion and gives an impulse on coughing; and when the hernial opening is small reduction is accompanied by a gurgling sound.

In children the appendix can sometimes be palpated in the hernial sac, more often in inguinal than in femoral hernias; it feels like a thick, round cord or a penholder. Sometimes it may be recognized by the elongated shape and hardness of the hernial mass. When the appendix is long and kinked or curled upon itself, or when there is retrograde strangulation of the central portion, it may feel like a double cord or be mistaken for a second testis.

The appendix in the hernial sac can hardly ever be felt in adults on account of the thick coverings of the hernia, and the excess of fat in the meso-appendix that is often present in these subjects. Tension, inflammation, or fluid in the sac may also interfere with the palpation of the appendix. When appendical hernias are exposed to considerable trauma, as they are when located in the femoral region, they become irreducible early because of inflammation and the formation of adhesions.

Local Signs of Inflamed Appendical Hernia.—The local signs of inflamed appendical hernia are: Redness of the skin, edema, induration of the overlying coverings, and gradual increase in the size of the tumor; tenderness and pain over the mass on pressure, and dullness on percussion. The tumor is hard or fluctuating, depending on whether or not an abscess has formed, and there is no impulse on coughing. There is often referred pain and tenderness above Poupart's ligament, but there is no rigidity of the muscles over the appendix region (McBurney's point) unless there is abdominal peritonitis.

These signs are absent in strangulation of the appendix when it is unaccompanied by appendicitis, and they do not appear until after infection takes place and inflammation develops. Kölliker and Muss reported cases of femoral hernia of the appendix which caused the patients to walk in a stooping posture. This sign is of little value because it is sometimes found in painful affections of the groin and also in abdominal appendicitis. Sheldon reported two cases of inflamed hernia of the appendix and in both, deep continued pressure over the tumor caused pain referred to the umbilicus.

Remsen reported an interesting case of hernial appendicitis in an infant: There was a scrotal swelling extending up beyond the external ring, and a constriction between the upper and middle thirds of the mass dividing it into two parts. At operation the lower half of the appendix was found in the upper sac and the lower sac contained a hydrocele.

Complications

Strangulation, inflammation, irreducibility, and foreign bodies in the lumen of the appendix are the most frequent complications of appendical hernia. As already pointed out in anatomy, strangulation is the first stage and infection and inflammation the second stage of appendicitis in the hernial sac. It is usually impossible to determine when strangulation ends and inflammation begins or vice versa. When the appendix is found gangrenous or perforated and the sac contains pus, both inflammation and secondary strangulation undoubtedly play a rôle in the process. It is only when appendical hernia is operated on early that strangulation can be diagnosed, and the constriction recognized at the base of a swollen edematous appendix. If the constriction is not promptly relieved, infection and inflammation set in—hernial appendicitis.

Strangulated Hernia of the Appendix.—When strangulated hernia of the appendix is incomplete and is not followed by inflammation, the symptoms are vague, often simulating those of strangulated omental hernia or a small Richter's hernia. There is an irreducible hernial mass that slowly increases in size with little or no pain and tenderness. Gastrointestinal and abdominal local symptoms are usually absent.

Appendicitis in the Hernial Sac.—Appendicitis in the hernial sac is often mistaken for strangulated hernia of the appendix. In the latter condition

the symptoms of appendicitis are absent. This error in diagnosis is perhaps due to the fact that operation is usually undertaken for a supposed strangulated enterocele or omentocoele, and the most striking local symptom is irreducibility of the hernia, which usually is due to inflammation, and not to constriction *per se* at the base of the appendix.

Symptoms.—The symptoms of hernial appendicitis are similar to those of abdominal appendicitis, namely, nausea, vomiting, colicky abdominal pain, distention and constipation. There is no intestinal obstruction or rigidity of the abdominal muscles in the appendix region. When the appendix is in the sac alone gangrene and perforation develop early, especially in femoral hernia.

Irreducibility of the Noninflamed Appendix.—Irreducibility of a non-inflamed appendix is nearly always due to adhesions of the appendix to the sac wall. Occasionally it is caused by cystic distention or kinking of the appendix; by adhesions to the cecum or to the peritoneum at the internal ring; or by adhesions between the appendix and testis in inguinal appendical hernias in males.

Foreign Bodies in the Appendix.—Foreign bodies are occasionally found in the lumen or in the wall of appendices in hernial sacs. The substances most frequently found are spicules of bone, fruit seeds, bits of enamel, glass, short hairs, bristles, gall-stones; intestinal parasites, such as tapeworms, thread worms, lumbricoids, trichocephalus, bilharzia, and echinococci. Sharp-pointed objects often work toward the tip of the appendix, perforate its wall and cause inflammation or appendicitis. Langley found a nail in the lumen of an appendical hernia in a man; and Eve found a broken blade of a hemostat beside the appendix in a hernial sac.

Kelloch found a pin imbedded transversely in the appendix and in the walls of the sac in an infant while operating for irreducible inguinal hernia. There had been no previous symptoms of inflammation or appendicitis in the hernia.

Other Complications.—Other conditions that may complicate hernia of the appendix are: Benign and malignant growths in the appendix; spontaneous rupture of an appendical abscess with the formation of a fecal fistula; tuberculosis of the appendix; cyst of the appendix; and hydrocele of the hernial sac.

Gowland reported the case of a woman, aged 56, who had a tense swelling the size of a hen's egg in the right groin. The mass was mobile from side to side, but fixed in the inguinal canal. The tumor had been previously aspirated by a physician who diagnosed it as a hydrocele of the canal of Nuck. Operation disclosed a sac filled with hydrocele fluid, and the tip of the appendix adherent to the lowest point of the sac. Evans reported the case of a boy, three and a half years old, who had an encysted hydrocele of the cord with the tip of the appendix adherent to the lowest point of the sac. Chitty

found the tip of the appendix adherent in a femoral sac. The condition of the appendix did not explain the severity of the symptoms, and on opening the abdomen he found a loop of small intestine strangulated by the tense appendix. Cernezzi reported a case of inguinal hernia of the appendix complicated by a large mesenteric cyst in the sac.

Differential Diagnosis

The symptoms of hernia of the appendix so closely simulate those of other conditions, that diagnosis before operation is often impossible. In children the appendix can sometimes be palpated in the hernial sac, but very seldom in adults. There is often a history of a small reducible tumor, and sometimes there have been previous attacks of appendicitis, when the mass became temporarily irreducible. When inflammation develops, the tender, painful, irreducible tumor gradually increases in size, accompanied by the general symptoms and local signs of appendicitis. When the inflamed appendix accompanies the cecum, colon, omentum, or small intestine into a large hernial sac, the only symptoms of appendicitis may be those of hernial peritonitis.

Appendical hernia may be mistaken for the following conditions:

1. **Omental Hernia.**—An irreducible omental hernia presents a hard irregular mass which is insensitive to pressure. Pressure or traction on the tumor does not cause pain referred to the appendix region. A strangulated omental hernia seldom has any signs of intestinal obstruction, and the symptoms of inflammation characteristic of appendicitis are usually lacking.

2. **Partial Enterocoele.**—A partial strangulation or “nipping” of the intestinal wall gives the symptoms of strangulated hernia without complete obstruction of the bowel. Vomiting and shock are more marked than in strangulated hernia of the appendix, and the symptoms of appendicitis are lacking. However, in delayed cases it is usually impossible to make a diagnosis except at operation.

3. **Strangulation or Torsion of the Ovary and Tube.**—Hernia of the ovary and tube is found most often in infants and children, and occurs with nearly equal frequency on the right and left sides. There is almost always a history of an irreducible tumor present since birth. It is globular in shape, painful on pressure, and moves with the uterus when the latter is palpated through the rectum or vagina. Torsion of the tube occurs occasionally, and as the symptoms are similar to those of strangulation, diagnosis is seldom made except at time of operation. Several cases are reported in the literature in which the ovary and tube accompanied the appendix into a hernial sac.

4. **Adenitis.**—Inflamed lymphatic glands, especially in the femoral region, may simulate a hernia of the appendix. The inflamed gland is usually movable and the examining fingers can be passed beneath it, showing that it is outside the hernial sac. Frequently more than one gland is enlarged. In rare instances, a large inflamed or abscessed gland in the femoral region con-

ceals a strangulated hernia. Battle observed appendicitis in a femoral hernia associated with inflammation of the overlying lymphatic glands.

5. **Strangulated Epiploic Appendix.**—Strangulation or torsion of an epiploic appendix must be distinguished from hernia of the appendix. Hernia of an epiploic appendix is most frequently found on the left side, where it is attached to the sigmoid. The symptoms are not unlike those of omental hernia.

6. **Pus in the Hernial Sac.**—Very rarely the pus from a gangrenous abdominal appendicitis gravitates downward into a congenital hernial sac. The inflammation at the neck of the sac causes the tumor to become irreducible. In the early stages the mass is fluctuating, and accompanied by the symptoms of purulent abdominal appendicitis. This condition is to be borne in mind in examining “strangulated” inguinal hernia.

7. **Disease of the Testis.**—Disease of the testis must be thought of, especially when the testis lies in the inguinal canal.

8. **Cyst of the Cord or Canal of Nuck.**—A hydrocele of the cord or of the canal of Nuck is fixed in position or only slightly movable. The tumor does not vary in size and it is insensitive to pressure.

9. **Other Conditions.**—Other affections that must be distinguished from hernia of the appendix are: Prehernial lipoma, torsion of the spermatic cord, intestinal diverticulum, supernumerary testis, reducible and irreducible hernias of the intestine, bladder, and other viscera. Large or encysted appendices have been mistaken for the hernial sac or for a second sac. A long slender appendix must not be taken for the round ligament or spermatic cord.

10. **Meckel's Diverticulum.**—A Meckel's diverticulum in an inguinal or femoral hernia can rarely be distinguished from an appendical hernia, except at operation, and even then, mistakes are liable to be made. It is probable that some of the cases of large appendices found in hernias, especially on the left side, are hernias of Meckel's diverticulum. If the appendix has a large lumen, a thin wall, and is abnormally long, an attempt should always be made to identify the cecum so as to confirm the diagnosis. A Meckel's diverticulum has no mesentery, while about 50 per cent of appendices in hernias have mesenteries.

Cases are on record in the literature in which fatal results have followed the mistaking of the inflamed appendix for the spermatic cord, and leaving the appendix undisturbed in the sac while the other contents were reduced.

Hutchinson reported a case which illustrates the difficulties of distinguishing a long thin appendix adherent by its tip to the hernial sac, from a fallopian tube. On account of the adhesions, it was impossible to determine whether or not there were fimbriae, and diagnosis was not positive until after a microscopical section had been made.

Prognosis

Strangulation and inflammation occur more frequently in appendical hernias, than when the appendix is intraabdominal. When the appendix is alone in the hernial sac, it occupies an unprotected position and is subject to considerable trauma with the result that adhesions to the sac wall form early. In femoral hernia, after adhesions have formed and the mass has become irreducible, the irritation produced by the movements of the thigh and the constriction of the sharp edge of Gimbernat's ligament often lead to strangulation and hernial appendicitis.

Strangulation and inflammation are much more frequent in femoral hernia than in inguinal hernia. Gangrene and perforation occur earlier in femoral hernia than in inguinal hernia.

The mortality rate of appendicitis in the hernial sac is lower than in abdominal appendicitis, because the process in the hernial sac usually becomes walled off early in the disease and the infection is localized within the sac. On account of the indefinite symptoms in inflamed hernia of the appendix, the diagnosis is often delayed, and operation is resorted to later than in abdominal appendicitis.

Whenever appendicitis in a hernial sac is suspected, operation should be undertaken as soon as possible. The appendix should always be removed, even when it is apparently healthy. A number of cases are recorded in the literature in which a hernia of the appendix was reduced into the abdomen and an operation for appendicitis was required later. In other instances when the hernia recurred, the appendix entered the new sac and became inflamed.

Appendicitis in a hernial sac may be acute or chronic. The attacks have a tendency to occur more frequently and at shorter intervals than in abdominal appendicitis. However, the acute form seldom runs as stormy a course in the hernial sac as it does in the abdomen, and even when perforation occurs in the hernial sac, the symptoms usually remain those of subacute appendicitis. I have collected from the literature 512 cases of hernia of the appendix alone; in 124 there were symptoms of appendicitis.

Treatment

Truss.—The truss treatment of appendical hernia is never to be advised, even when the hernia is reducible, on account of the danger of the pressure and irritation causing an acute attack of appendicitis. In irreducible hernia the pressure of the pad on the appendix causes so much pain that the truss cannot be tolerated.

Taxis.—Taxis must never be attempted in either strangulated or inflamed hernia of the appendix, as there is danger of rupturing a nonperforated appendix or an unsuspected abscess, and perhaps forcing pus into the abdo-

men, which would probably cause a fatal peritonitis. There is also the possibility of reducing *en masse* a gangrenous intestine along with the appendix.

Pick reported a case in which strangulated intestine was reduced *en masse* with the appendix; five days later the patient died of peritonitis. Fatal results following taxis have also been reported by Tacke, Bouglé and Dartigues, Biehat, and others.

The Operation

The Noninflamed Appendix.—The operation is the treatment of choice for hernia of the appendix. The appendix should always be removed and never reduced into the abdominal cavity. If it cannot be removed through



Fig. 215.—Method of blocking the mesocecum in the operation for appendectomy under local anesthesia.

the hernial opening, because only a part of it is in the sac and adhesions and immobility of the cecum prevent its base from being drawn down into view, the incision should be extended upward through Poupart's ligament in femoral hernia, and beyond the internal ring in inguinal hernia.

However, a better plan is to make a second incision under local anesthesia, in the lower abdomen and remove the appendix at the ceco-appendical junction after blocking the mesocolon. (Fig. 215.) This method permits a

firmer closure of the hernial opening than the first method, which divides and weakens the internal ring, favoring recurrence.

The appendix is crushed at its base with a forceps, the latter removed and a ligature applied in the groove. The appendix is cut away, and if haste is necessary, the stump can be cauterized with phenol, followed by alcohol, and dropped back into the abdomen, as advocated by Wyeth. The customary practice is to ligate, cauterize and invert the stump by means of a pursestring suture.

Diseased omentum in the sac should be ligated and excised. In large hernias other viscera such as the cecum, colon, and small intestine accompany the appendix, and should be returned to the abdomen.

In dealing with appendiceal hernia complicated by extensive omental adhesions, the operation is simplified if the omentum is first ligated and divided in small sections, and then the sac removed with the end of the omentum still adherent to it. Subperitoneal fat may be mistaken for omentum if adhesions are very extensive or if there is inflammation or suppuration. If adhesions prevent the cecal attachment of the appendix from being brought down into the wound, the base of the appendix can often be exposed by turning up a cuff of serosa and peeling the appendix out—the “coat sleeve” method.

Appendicitis in the Hernial Sac.—When perforation has not taken place, the appendix should be removed in the manner already described, the hernia repaired and the wound closed without drainage. (The indications for the use of the inguinal and femoral incisions for irreducible femoral hernia are discussed in the chapter on femoral hernia.)

If perforation or gangrene has developed or if an abscess has formed, the sac should be opened and any remaining portion of the appendix removed, the wound drained and the hernia repaired at a later time. In dealing with a gangrenous femoral hernia of the appendix, Schrager stitched the sac to the skin and converted it into a drainage tube.

If gangrene has extended beyond the tip of the appendix it is not safe to try to pull the appendix down to ligate it at the base. A better plan is to make a second incision, either a lateral rectus or a McBurney, and draw the cecum and appendix up into the wound and complete the operation as for abdominal appendicitis. When the appendix can be removed through the hernial opening, it is never advisable to anchor the stump to the neck of the sac; it should be pushed back into the abdomen and covered with a piece of omentum if the latter is available.

Retrograde Strangulation.—In retrograde strangulation only the central portion of the appendix is in the sac. The tip lies in the abdomen internal to the constricting ring, and it is nearly always gangrenous and often perforated, because the constriction obstructs its blood supply at two points. The ring should be enlarged and the tip exposed and removed with as little dissection as possible to avoid spreading the infection. (Fig. 4.)

Fecal Fistula in a Hernial Sac.—When an appendical abscess is drained by incision or ruptures spontaneously a fecal fistula often follows. The intestinal opening will close of its own accord in a few weeks, providing all of the appendix has been destroyed. If the fistula persists, it is necessary to open the wound, remove the remainder of the appendix, and allow the wound to heal before attempting to repair the hernia.

The treatment of hernial appendicitis and its complications is similar to the treatment for abdominal appendicitis. (Space will not permit further consideration of it here; the subject is fully described in textbooks on surgery and in special monographs, such as the exhaustive works of Kelly and Hurdon, and Deaver.)

Bibliography

HERNIA OF THE VERMIFORM APPENDIX

- AMYAND, C.: Observation d'une épingle renfermée dans l'appendice du cæcum. *In*: Portal, A., vol. v, p. 82.
- ANDEREGG, J.: Die Radicaloperation der Hernien. *Deutsche Ztschr. f. Chir.*, Leipz., 1886, xxiv, 207-325.
- BARIÈTY, L.: Des hernies de l'appendice cæcal compliquées d'appendicite. Thèse, Paris, 1895.
- BATTLE, W. H.: A case of irreducible femoral hernia containing the vermiform appendix; operation; recovery. *Lancet*, Lond., 1899, i, 1223.
- BERENGERIUS CARPUS: See Portal, A.: vol. i, 275.
- BICHAT, H.: Contribution à l'étude de l'appendicite herniaire; distention d'un sac herniaire au cours d'une appendicite aiguë suppurée, simulant une hernie étranglée. *Arch. gén. de méd.*, Par., 1903, i, 335-342.
- BOUGLÉ AND DARTIGUES: Hernie crurale droite étranglée renfermant l'appendice. Kélotomie. Réduction de l'appendice sain. Trois jours après, étranglement d'une hernie inguinale droit renfermant l'appendice enflammé (etc.). *Bull. et mém. Soc. anat. de Paris*, 1900, 6 s., ii, 73-76.
- BRIANCON: Hernies de l'appendice iléo-cæcal. Thèse, Paris, 1897.
- CABARET, P. J.: Hernie crurale de l'appendice cæcal. *J. d. conn. Méd.-Chir.*, Par., 1842, x, pt. i, 54-57.
- CERNEZZI, A.: Sull' ernia dell' appendice vermiforme del cieco. *Clin. chir.*, Milano, 1903, x, 297-307.
- CHARNOIS, J.: Des hernies du cæcum compliquées d'appendicite. Lyon, 1894.
- CHARYAU: See Cabaret, P. J.: p. 56.
- CHITTY, H.: Two cases of strangulated intestine partly contained in hernial sacs. *Brit. J. Surg.*, Bristol, 1919-1920, vii, 545-546.
- CLOGG, H. S.: Some remarks on inguinal hernia in children, based on an experience of 126 cases submitted to operation. *Practitioner*, Lond., 1907, lxxix, 364-381.
- CLUSS: Die Bruchoperationen und deren Dauerresultate von 1896-1903. *Beitr. z. klin. Chir.*, Tübing., 1904, xlv, 503-594.
- COCUZZA, V.: Mille e cinquecento operazioni per cura radicale d'ernia inguinale. *Rif. med.*, Napoli, 1908, xxiv, 57-68.
- DEAVER, J. B.: Appendicitis. Phila., Blakiston, 1913.
- DE GARMO, W. B.: Hernia of the appendix. Report of 21 cases. *Post-Graduate*, N. Y., 1908, xxiii, 667-678.
- DESMOSTHEN: See Girolamo, L.: p. 513.
- DUJARIER AND CASTAGNE: Hernie inguinale droite de l'appendice iléo-cæcal, avec situation extra-péritonéal de l'appendice. *Bull. Soc. anat. de Par.*, 1899, lxxiv, 180-182.
- EVANS, A.: The vermiform appendix adherent in a hernial sac and simulating an encysted hydrocele of the cord. *Lancet*, Lond., 1904, i, 296-297.
- EVE, D.: Herniotomy with peculiar complication; appendix attached to testicle. *South. Pract.*, Nashville, 1899, xxi, 151-153.
- FALLOPIUS: See Portal, A.: vol. vi, 592.

- FANTINO, G.: Considerazioni cliniche su 4580 operazioni per ernia. Clin. chir., Milano, 1912, xx, 1033-1084.
- FROMME, A.: Beiträge zur Appendicitis-frage auf Grund der Erfahrungen der Göttinger Klinik in den letzten vierzehn Jahren. Deutsche Ztschr. f. Chir., Leipz., 1910-1911, cviii, 429-550.
- DE GARENGEOT, R. J. C.: Traité des operations de chirurgie. 2nd ed., Paris, Huart, 1731, i, 237.
- GIROLAMO, L.: L'ernia dell' appendice vermiforme del cieco. Rif. med., Napoli, 1914, xxx, 508-523; 546-551.
- GOWLAND, W. P.: The vermiform appendix adherent in a hernial sac and by occluding the distal portion of that sac leading to the formation in it of a hydrocele. Lancet, Lond., 1904, i, 432.
- GRAY, H. T.: Lesions of the isolated appendix vermiformis in the hernial sac. Brit. M. J., Lond., 1910, ii, 1142-1144.
- GUSSEW, V.: Beitrag zur Therapie der eingeklemmten Bruche auf Grund von 420 Fällen. Deutsche Ztschr. f. Chir., Leipz., 1913, exxiv, 155-192.
- HESSELBACH, F. C.: Neueste anatomisch-pathologische Untersuchungen über den Ursprung und das Fortschreiten der Leisten- und Schenkelbrüche. Wurzburg, J. Stahel, 1814.
- HÉVIN, P.: Cours de pathologie et de therapeutique chirurgicales. Paris, Mequignon, 1785, p. 407.
- HILGENREINER, H.: Statistik über 2238 operativ behandelte Hernien. Beitr. z. klin. Chir., Tübing., 1910, lxi, 431-458.
- HOFMAN, K. R.: Beiträge zur Kenntniss der Hernien des Processus vermiformis. Deutsche Ztschr. f. Chir., Leipz., 1897, xlv, 8-16.
- HONORÉ, S.: De l'appendicite herniaire. Thèse, Paris, 1903.
- HUTCHINSON, J.: On the vermiform appendix in relation to external hernia. Brit. M. J., Lond., 1899, ii, 1089-1094.
- JACQUEMIN, F.: Étude clinique de l'appendicite herniaire inguinale et crurale. Thèse, Paris, 1905.
- JATA, F.: Ueber Hernien des Wurmfortsatzes. Centralbl. f. Chir., Leipz., 1898, xxv, 1262.
- JAVANELLI, C.: See Rivet, A.: p. 721.
- KELLOCH, T. H.: A case of incarceration of the vermiform appendix containing a foreign body (pin) in the sac of an inguinal hernia in a child. Lancet, Lond., 1909, ii, 294-295.
- KELLY, H. A., AND HURDON, E.: The vermiform appendix and its diseases. Phila., W. B. Saunders Co., 1905.
- KÖLLIKER, T.: Zur Diagnose des Wurmfortsatzes als Bruchinhalt. Centralbl. f. Chir., Leipz., 1901, xxviii, 792.
- LANGLEY, R. B.: Hernia of the appendix with foreign body perforation of the hernial sac. J. Am. M. Assn., Chi., 1921, lxxvii, 706-707.
- LEDUGOU, U.: De l'étranglement de l'appendice iléo-cœcal dans la canal crural. Thèse, Paris, 1905.
- LEVY, A.: Complications des hernies de l'appendice; appendicite herniaire; étranglement de l'appendice hernié; hernie appendiculaire enkystée. Arch. prov. de chir., Par., 1903, xii, 393; 481; 531.
- LOCKWOOD, C. B.: The morbid anatomy and pathology of encysted and infantile hernia. Med.-Chir. Tr., Lond., 1886, lxix, 479-515.
- MACEWEN, J. A. C.: Hernia of the vermiform appendix with an account of four cases. Ann. Surg., Phila., 1909, xlv, 516-523.
- MAGRUDER, E. P.: Discussion: Wash. M. Ann., 1907, vi, 140.
- MERLING, F.: Diss. sistens processus vermiformis anatomiam pathologicam. I. D., Heidelberg, 1836.
- MORGAGNI, J. B.: De sedibus, et causis morborum. Venetiis, Remondiniana, 1761, p. 180.
- MUSS, N.: Zur Diagnose des Wurmfortsatzes als Bruchinhalt. Centralbl. f. Chir., Leipz., 1901, xxviii, 1037.
- NAQUET, P.: Contribution à l'étude des hernies de l'appendice vermiculaire et de leurs complications. Thèse, Paris, 1900.
- NIEDLICH: Appendix und Appendicitis im Bruchsack. Beitr. z. klin. Chir., Tübing., 1920-1921, cxxi, 167-190.
- OSTY, E.: De l'appendicite herniaire. Thèse, Paris, 1900.
- PASCAL AND PILLIET: Apoplexie de l'appendice hernie. Bull. de la Soc. anat. de Par., 1898, xii, 352-354.
- PICK, T. P.: Case of strangulated vermiform appendix; operation; death; remarks. Lancet, Lond., 1880, i, 801.

- POLLOSSON, M.: De l'étranglement herniaire de l'appendice iléo-cæcal. Lyon méd., 1893, lxxiii, 75-81.
- PORTAL, A.: Histoire de l'anatomie et de la chirurgie. Paris, P. F. Didot, 1773, vi, 592.
- REMSSEN, C. M.: Appendicitis in an infant sixteen days old with appendix in an inguinal hernial sac. Ann. Surg., Phila., 1912, lvi, 910-914.
- RIVET, A.: Les hernies de l'appendice vermiforme. Gaz. d. hôp., Par., 1898, lxxi, 721-724.
- SCARPA, A.: Sull'ernia memorie anatomico-chirurgiche. 2nd ed., Pavia, Dalla stamperia Fusi e Co., Success. Galeazzi, 1819.
- SCHRAGER, V. L.: Routine appendectomy through right indirect inguinal hernial sac in afebrile cases. Surg. Clin., Chi., 1919, iii, 387-389.
- SHELDON, J. G.: Hernia of the vermiform appendix and the removal of the appendix during operations for right inguinal hernia. Am. Med., Phila., 1903, vi, 668-669.
- SONNENBURG, E.: Pathologie und Therapie der Perityphlitis. 7th ed., Leipzig, F. C. W. Vogel, 1913.
- STAATSMANN, K.: Fälle von primärer Einklemmung des Wurmfortsatzes. München. med. Wehnschr., 1904, li, 603-604.
- TACKE, F.: Epityphlitis im Bruchsack. Beitr. z. klin. Chir., Tübing., 1901, xxix, 61-76.
- TAILLEFER, E.: Étranglement de l'appendice dans canal crural. Cong. franç. de chir., Par., 1901, xiv, 605-607.
- TARAMELLI: See Cabaret P. J.: p. 56.
- THIÉRY, P.: Appendicocèle inguinale. Étranglement, kélotomie. Guérison. Réflexions sur l'étranglement herniaire partiel. Bull. Soc. anat. de Par., 1892, lxxvii, 499-505.
- TRITSCHLER, F. W. G.: Diss. sistens observationes in hernias præcipue intestini cæci. I. D., Tübing., 1806.
- VAN HOOK, W.: Strangulated inguinal hernia of a cystic appendix vermiformis. Am. Gynec. & Obst. J., N. Y., 1896, viii, 337-349.
- VEREBÉLY, T.: Ueber die Komplikationen der Bruchoperation durch den Wurmfortsatz. Beitr. z. klin. Chir., Tübing., 1906, xlviii, 613.
- VESALIUS, A.: See Portal, A.: vol. i, 425.
- VÉSIGNIE, H.: Contribution à l'étude des hernies de l'appendice et du cæcum. Thèse, Paris, 1903.
- VIDUS, VIDIUS: See Portal, A.: vol. i, 592.
- WASSILJEW, M. A.: Ueber Appendicitis in Inguinalhernien bei Männern. Arch. f. klin. Chir., Berl., 1904, lxxiii, 179-214.
- WEYPRECHT, K.: Erfahrungen über die Operation des eingeklemmten Bruches. Arch. f. klin. Chir., Berl., 1903-4, lxxi, 31-96.
- WÖLFLE, A.: Incarceration einer Abdominal-Cyste im rechten Leistenkanale; Operation, Heilung. Arch. f. klin. chir., Berl., 1877, xxi, 432-440.
- WOOD A. C.: Appendicular femoral hernia, with notes of one hundred cases. Ann. Surg., Phila., 1906, xliii, 668-703.

CHAPTER XXV

HERNIA OF MECKEL'S DIVERTICULUM

Synonyms.—Littre's hernia; Hernia of the appendix ilei.

Definition.—A hernia of Meckel's diverticulum is a protrusion of a diverticulum of the ileum through a hernial opening.

(Meckel's diverticulum in umbilical hernia is not dealt with in this chapter, as the subject is discussed in the chapter on umbilical hernia.)

Historical

The possibility of a diverticulum of the ileum appearing in a hernia was suggested by Ruysch, in his report of an autopsy in 1683. Littre, in 1700, reported two cases, and described the diverticulum as a secondary formation arising from the intestine opposite the hernial ring. Méry, in 1701, reported a case; and Walther, in 1778, dissected a Meckel's diverticulum found in an inguinal hernia. Richter, in 1785, regarded these diverticula simply as partial enteroceles, while Scarpa, in 1804, briefly alluded to them along with appendical hernias and partial enteroceles. Boyer, in 1822, and Malgaigne, in 1840, described them. Riecke, in 1841, was the first to suggest calling them Littre's hernias.

Broca, in 1853, drew attention to the difficulty of distinguishing the symptoms of partial enterocoele and hernia of Meckel's diverticulum. Cabaret, in 1842, reported a case of femoral hernia of the appendix which undoubtedly was a Meckel's diverticulum. There has been much confusion in distinguishing hernias of Meckel's diverticulum from appendical hernia.

An important monograph was published in 1907, by Forgue and Riche, who collected 52 cases of hernia of Meckel's diverticulum from the literature, exclusive of the umbilical variety. Gray, in 1908, was able to find 60 cases. Pabst, in 1910, collected from the literature 89 cases of inguinal and femoral hernia of Meckel's diverticulum and added one of his own. In 1923 I collected 147 cases of hernia of Meckel's diverticulum.

Anatomy

There are two anatomic varieties of hernia of Meckel's diverticulum, the noninflamed and the inflamed:

1. **Simple Noninflamed Hernia of Meckel's Diverticulum.**—In simple hernia of Meckel's diverticulum, the diverticulum may lie free in the sac as in the cases observed by Littre in 1700, and by Cazin in 1862. However, it is

most often adherent to the sac wall. Mignon found a diverticulum the same size as the small intestine, and about 3 inches (7.5 cm.) long; it was adherent to the bottom of the sac. Howse found one that was larger than the intestine, and was nearly $2\frac{1}{2}$ inches long (6 cm.); it was adherent by its tip to the sac.

Many writers have noted the intimate connection between the diverticulum and the testis or epididymis in inguinal hernias. Sometimes there is a kinking of the diverticulum upon itself, with adhesions, and rarely there is a cyst of a diverticulum in a hernial sac.

The diverticulum may be accompanied by small intestine, which is sometimes strangulated, or by omentum alone. Hunter found the sigmoid and ileum with the diverticulum. Auvray suggested that adhesion of the diverticulum to the sac wall is sometimes the cause of strangulation of the intestine in the sac, and he reported a case in which this complication occurred in a strangulated inguinal hernia, in an infant seven months old. Sinclair observed an unusual case of hernia of Meckel's diverticulum of a portion of the intestine some distance from the diverticulum, in a femoral hernia. The tip of the diverticulum was adherent to the sac wall and strangulation was undoubtedly caused by the partial enterocele entering the sac. In some cases, the presence of the diverticulum at the neck of the sac prevented the reduction of the hernia by taxis. Strangulation of the isolated hernia of Meckel's diverticulum is more frequent in femoral than in inguinal hernia.

2. Hernial Diverticulitis.—Inflammation and strangulation of a hernia of Meckel's diverticulum has the same etiology and pathology as hernial appendicitis.

As with appendical hernia, inflammation is much more frequent than strangulation; when so-called "strangulation" occurs it is nearly always simply secondary to the inflammation and infection. True strangulation of a Meckel's diverticulum is rare. Sometimes it is impossible to determine whether inflammation or strangulation occurs first.

As in hernial appendicitis, diverticulitis is usually confined to the hernial sac; occasionally it spreads beyond the hernial ring and causes abdominal peritonitis.

Etiology

Hernia of Meckel's diverticulum is rare. In 600 cases of Meckel's diverticulum, collected in the literature by Forgue and Riche, there were only 52 instances of hernia. In the order of frequency the condition of the diverticulum was as follows: Closed, open, inflamed; the seat of benign adenomas, and the site of intestinal cysts.

Age.—Hernia of Meckel's diverticulum is most frequently found in adults and in middle-aged subjects. In the 147 cases I collected from the literature the ages were as follows:

1 to 10 years	23 cases
10 to 20 years	11 cases
20 to 30 years	13 cases
30 to 40 years	14 cases
40 to 50 years	20 cases
50 to 60 years	13 cases
60 to 70 years	13 cases
Over 70 years	5 cases
Age not given	35 cases
	<hr/> 147 cases

Sex.—As in other affections of Meckel's diverticulum, hernia is most frequent in males, the proportion being of 79 males (70.6 per cent) to 33 females (29.4 per cent).

Side Affected.—In 111 of the 147 cases I collected, 83 were on the right and 28 on the left side.

Site.—Hernia of Meckel's diverticulum usually occurs in the inguinal region. In the series I studied 96 hernias were inguinal and of this number 69 were in males, 12 in females, and in 15 the sex was not stated. In 67 the hernia was on the right side, in 22 it was on the left side, and in 7 the side was not given.

Thirty-four hernias were in the femoral region. Of these 21 were in females, 10 in males, and in 3 the sex was not given. The right side was most frequently affected, 16 of the hernias being on that side and 6 on the left side; in 12 cases the side was not mentioned.

One hernia was in the sciatic region. The patient was a woman aged 47; strangulation was followed by a fecal fistula and she recovered.

Predisposing and Active Causes.—The same predisposing and active causes that are described for hernia of the small intestine are also responsible for hernia of Meckel's diverticulum. The diverticulum lies free in the abdominal cavity until it enters the hernial sac.

Ekehorn believed that the tip of the diverticulum was sometimes drawn down into the sac by the descent of the testis to which it was attached. This theory is not generally accepted, and it is less plausible as an explanation for this hernia than for hernia of the appendix, cecum or sigmoid.

Symptoms and Diagnosis

Hernia of Meckel's diverticulum presents no special symptoms on which a diagnosis can be based, or the presence of a diverticulum even suspected. The symptoms are those common to appendical hernia, partial enterocele, and epiploitis in a hernial sac. Inflammation and adhesions to the sac wall often result in the tumor becoming partially or completely irreducible.

Simple hernia of Meckel's diverticulum is completely reducible if it is not adherent to the sac. Often a gurgling sound is heard when the diverticulum is reduced. When the hernia is incompletely reducible, due to the presence of adhesions, a hard fibrous cord is felt just above the testis after the greater portion of the hernia has been reduced. In this respect it re-

sembles a hernia of the appendix. There is seldom diarrhea, although it was present in the case reported by Tédénat.

Strangulation.—The symptoms of strangulation of hernia of Meckel's diverticulum were first described by Littré. They are similar to those of partial enterocele and hernia of the appendix. The general symptoms are not severe; there is seldom vomiting and obstruction is not complete. There is a small tumor in the affected region, which slowly increases in size, and the local signs, pain, tenderness, tenseness and irreducibility are more marked than the general symptoms. Many of the older writers reported cases of untreated strangulation of Meckel's diverticulum, which was unrecognized, and resulted in the formation of an abscess that ruptured and terminated in a fecal fistula.

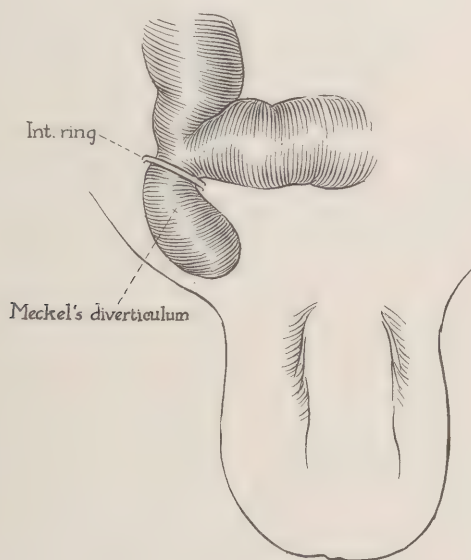


Fig. 216.—Schematic drawing of an inguinal hernia of Meckel's diverticulum.

Diagnosis.—A Meckel's diverticulum should be suspected when the hernial contents apparently consist of a single loop of intestine, which seems to have a blind end, or which appears to terminate in a culdesac that is adherent to the sac wall. A hernia of Meckel's diverticulum is larger than an appendical hernia, and the symptoms are usually less acute because of the larger lumen of the intestine. When the sac is opened, the absence of a mesentery should cause the operator to think of a Meckel's diverticulum. (Fig. 216.)

Prognosis

The prognosis for hernia of Meckel's diverticulum is more favorable than for ordinary enteroceles because the intestinal tube is not obstructed and is only indirectly involved. The mildness of the local symptoms is often

responsible for delayed treatment in strangulation. General peritonitis occurs more frequently as a complication than is ordinarily supposed. The indications for operative treatment are the same as for other intestinal hernias.

Should a fecal fistula occur, there is danger of the patient dying of inanition, on account of the opening being high up in the intestinal tract. The fistula may close spontaneously or it may remain open for a long time. It should always be closed by operation as soon as possible. Tédénat saw a case in which it remained open for six years and later an abscess developed at this point, caused a general peritonitis, and the patient died.

Treatment

The radical operation with excision of the diverticulum is the treatment of choice for hernia of Meckel's diverticulum. If the diverticulum is reduced into the abdominal cavity, there is danger of subsequent attacks of diverticulitis.

Whether the diverticulum is alone in the hernial sac or with other viscera, it should be resected at the point where it joins the small intestine, and the opening closed by a careful intestinal suture. This suture line should be covered over with a piece of omentum, if it can be secured, to prevent postoperative adhesions. Amyand was the first to practice ligature-excision of a fistulous Meckel's diverticulum, and his patient recovered.

The abdominal intestine should always be examined for some distance beyond the attachment of the diverticulum, for evidence of beginning necrosis or gangrene. A number of cases have been recorded in the literature in which perforation and peritonitis developed after the reduction of an apparently nongangrenous diverticulum. The treatment of strangulated hernia associated with a Meckel's diverticulum is the same as for intestinal hernia alone.

In 76 of the 147 cases of hernia of Meckel's diverticulum which I collected from the literature, the termination of the disease was as follows:

	NO. CASES	RECOVERIES	DEATHS
Diverticulum excised	61	58	3
Operation and drainage	4	3	1
Spontaneous fistula	5	3	2
Operation—diverticulum reduced into abdomen	6	4	2 {symptoms continued
	76	68	8

Bibliography

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- AMYAND, C.: Of an iliac passion occasioned by an appendix in the ilion. *Phil. Tr., Lond.*, 1744-1745, xliii, 369-370.
- AUVRAY, M.: Hernie inguinale étranglée chez un enfant de sept semaines; kélotomie, guérison. *Bull. et mém. Soc. de chir., de Par.*, 1905, xxxi, 1014-1019.

- BOYER, A.: *Traité des maladies chirurgicales*. Paris, Migneret, 1822, viii, 5.
- BROCA, P. P.: *De l'étranglement dans les hernies abdominales, et des affections qui peuvent simuler*. Thèse de concours, Paris, 1853.
- CABARET, P. J.: *Hernie crurale de l'appendice cæcal*. J. d. conn. méd.-chir., Par., 1842, x, 54-56.
- CAZIN, H.: *Étude anatomique et pathologique sur les diverticules de l'intestin*. Thèse, Paris, 1862.
- EKEHORN, G.: *Die Bruche des Meckel'schen Divertikels*. Arch. f. klin. Chir., Berl., 1901, lxiv, 115-133.
- FORGUE, E., AND RICHE, V.: *Le diverticule de Meckel*. Paris, O. Doin, 1907.
- GRAY, H. T.: *Some remarks on herniæ in which Meckel's diverticulum was present*. Brit. M. J., Lond., 1908, ii, 909-912.
- HOWSE, C. B.: *A case of congenital right inguinal hernia containing a Meckel's diverticulum adherent to the apex of the sac*. Lancet, Lond., 1906, i, 224.
- HUNTER, H.: *The occurrence of the diverticulum ilei*. J. Anat. & Physiol., Lond., 1891-1892, xxvi, 91.
- LITTRÉ, A.: *Observation sur la nouvelle espèce de hernie*. Hist. Acad. roy. d. sc., 1700, Par., 1719, mém. 300-310.
- MALGAIGNE, J. F.: *Examen des doctrines reçues jusqu'à ce jour sur l'étranglement des hernies*. Gaz. méd., Par., 1840, viii, 577-582; 609-615; 641-646.
- MECKEL, J. F.: *Beiträge zur Entwicklungsgeschichte des Darmkanals*. Deutsches Arch. f. d. Physiol., Halle, 1815, i, 293-296.
- MÉRY, J.: *Observations sur les hernies*. Mém. Acad. roy. d. Sc., Par., 1701, p. 273.
- MIGNON, M. A.: *Diverticule de Meckel inclus dans un sac de hernie inguinale droite*. Bull. et mém. Soc. de chir., Par., 1903, xxix, 485-486.
- PABST, F.: *Ein Meckel'sches Divertikel in einer Hernia interparietalis inguinalis incarcerata dextra*. Beitr. klin. Chir., Tübing., 1910, lxix, 646-692.
- RICHTER, A. G.: *Abhandlung von den Brüchen*. Göttingen, J. C. Dieterich, 1785.
- RIECKE, K. F.: *Ueber Darm-Anhangs-Bruche (Herniæ Littricæ)*. Berlin. A. Hirschwald, 1841.
- RUYSCH, F.: *Observationum anatomico-chirurgicarum*. Amstelodami, Henricum Viduam & T. Boom, 1691, p. 23.
- SCARPA, A.: *Sull'ernia memorie anatomie-chirurgiche*. 2nd ed., Pavia. Della stamperia Fusi e co., success. Galeazzi, 1819.
- SINCLAIR, N. F.: *An unusual hernia*. Lancet, Lond., 1922, ii, 762.
- TÉDENAT, E.: *Hernie diverticulaires étranglées et pincement herniaire*. Montpel. méd., 1885, 2 s., iv, 407-429.
- WALTHER, A. F.: *See Sabatier, C.: Traité complet d'anatomie*. Paris, T. Barrios, 1798, iii, 99.

CHAPTER XXVI

HERNIA OF THE BLADDER

Synonyms.—Vesical hernia; Cystocele; Cystic hernia.

Definition.—Hernia of the bladder is a protrusion of a part of the bladder through a normal or abnormal opening in the abdomen or pelvis.

It constitutes about 1 per cent of all hernias found in adults and is less frequent in children. Brunner collected the records of 1,841 cases of hernia and found bladder hernia in 1 per cent; in 2,543 consecutive hernia operations gathered by Moynihan, there were 23 cases of bladder hernia. Lucas-Championnière found 6 in 900 operations; Carli found 13 in 1,400 operations, while Eggenberger found it 75 times in 6,778 operations. In 6,776 cases of inguinal and femoral hernias reported by Coley and Hogue, there were 17 hernias of the bladder; 10 of these were in children under 14 years of age, and 7 in adults between 25 and 75 years of age.

Historical

The first case of bladder hernia was recorded by Plater, of Basle, in 1550, and the second case by Sala, of Venice, in 1620. Ruysch recorded a case in 1691 and Divoux, in 1732, reported one and collected several cases in the literature. The first attempt at surgical treatment was made in 1740 by Arnaud, who incised the bladder and tamponned the wound. In 1744 Günz wrote on this subject; ten years later C. Verdier published an important paper embracing a study of 20 cases, including a case of his own of femoral hernia of the bladder, the first one to be reported. He called attention to prevesical lipoma as a possible cause of bladder hernia, and described the symptoms of vesical hernia much as we know them today. He quoted Günz in this paper, stating that the date of Sala's case was 1520. As Sala was not born until 1579, and is referred to by Bartholin, who was born in 1616, as his teacher, it is apparent that Günz and C. Verdier were in error in crediting the discovery of bladder hernia to Sala. Pipelet, in 1768, reported a perineal hernia of the bladder in a man.

Following C. Verdier's paper, hernia of the bladder received scant attention, although it was sometimes seen during the course of an operation for strangulated hernia or at autopsy, until 1808 when Cooper described 2 cases in living subjects and 2 others discovered at autopsy. He was the first to suggest inflating the bladder in the hernia, as a means of diagnosis. About the same time, Sandifort reported a perineal hernia of the bladder, protruding through the vagina, and Christian saw one that interfered with parturi-

tion. In 1840 Verdier the second wrote a paper on the pathology of bladder hernia; and in 1847 Nélaton emphasized the importance of chronic distention of the bladder as a predisposing cause. The next interesting case of inguinal hernia of the bladder was reported by Krönlein in 1874, and another one by Leroux, in 1880; the following year an important paper was published by De la Barrière, and one by Duret, in 1883. Monod and Delagénère in 1889 wrote on the subject of lipoma as a cause of bladder hernia. Aue, in 1893, reported a case of femoral bladder hernia and reviewed the cases that had been reported up to that time. The same year papers appeared by Hedrich, Lucas-Championnière, Demoulin, and Piquet. Gueterbock, in 1891, reported a new case of femoral cystocele; articles were published by Lanz, in 1892, and by Schoonen and Guepin in 1893. In 1895 Jaboulay and Villard proposed the division of bladder hernia into the intraperitoneal, paraperitoneal and extraperitoneal varieties, a classification which is generally used today. Frœlich, in 1896, reported a femoral hernia that contained both bladder and intestine; about the same time Guinard saw a strangulated femoral hernia that contained intestine, bladder and ovary. Morin, in 1897, collected 19 cases of femoral hernia of the bladder. The next year Brunner published an exhaustive study based on 180 cases of bladder hernia collected from the literature up to 1896.

On account of the high mortality in preantiseptic days and the usual recurrence following the early operations for hernia, surgical measures were seldom undertaken except in the presence of strangulation, and then no attempt was made to expose the inguinal canal, consequently small vesical hernias were often overlooked, and the diagnosis was usually made post-mortem.

Up until the beginning of the present century the belief was prevalent that the primary suturing of bladder wounds was liable to invite urinary infiltration, fistula, or peritonitis. For this reason, many of the older surgeons sutured the edges of the bladder wound to the skin; if the patient survived, the fistula was closed at a second operation.

With the advent of the modern operations for inguinal hernia, which called for a free exposure of the canal and the isolation and ligation of the sac near the internal ring, a fresh impetus was given to the study of bladder hernia, and Moynihan found 112 cases of the inguinal and femoral vesical types recorded between 1890 and 1900.

Skeel collected 133 cases between 1896 and 1908; Heineck analyzed 164 vesical hernias that had appeared in the literature between 1896 and 1914. In 1918 Frank contributed a valuable paper on sliding hernia and reported 2 cases of this rare condition; the same year Blakeway reported 4 cases of strangulated bladder hernia. In 1919 Beck reported an interesting case of strangulated hernia of the entire bladder. Oliva in 1923 collected from the literature 16 cases of bladder hernia in children under 12, and added two cases of his own.

Statistics

In 1923 I collected from the literature, 406 cases of hernia of the bladder.

Sex.—In 305 cases the sex was given as follows:

Males	204
Females	101

Site and Side.—In 359 cases of inguinal and femoral hernia the site and side were as follows:

Inguinal				Femoral			
R.	L.	Bilateral	Side not given	R.	L.	Bilateral	Side not given
130	103	5	42	43	21	2	13

Other varieties were as follows:

Perineal	2
Sciatic	2
Ventral	5
Obturator	1

Relation of the Sac to the Peritoneum.—The relation of the bladder to the peritoneum in 306 cases was as follows:

Paraperitoneal	204
Extraperitoneal	85
Intraperitoneal	17

Diagnosis of the Bladder Hernia.—In 347 cases the time of diagnosis of the bladder hernia was as follows:

Before operation	25
During operation	279
After operation	43

Injury to the Bladder.—In the 406 cases of vesical hernia that I collected from the literature, the bladder was wounded during operation in 194 cases.

Mortality in Cases of Injury.—In 149 cases the result was given as follows:

Time of discovery of injury or of death	Recovered	Died
12 hours	2	1
1 day	3	2
2 days	0	2
3 days	1	5
5 days	2	3
8 days		1
Time not stated	118	9
	<hr/> 126	<hr/> 23

Mortality rate following discovery of injury after operation:

Time of discovery of injury	Recovered	Died
12 hours	1	1
24 hours		1
2 days		3
3 days		2
4 days		1
5 days		2
Time not stated	19	7

Duration of Fistula.—In 31 cases the duration of the fistula after the injury was given as follows:

1 day	10
5 days	2
7 days	1
2 weeks	1
4 weeks	5
6 weeks	1
8 weeks	3
Few weeks	3
Year or more	5

Anatomy

The bladder may make its exit through any of the normal hernial openings in the lower part of the abdomen or the pelvis, or it may come through at an abnormal point. It usually appears in the opening that is nearest to it. The usual varieties of bladder hernia are: Inguinal, femoral, perineal, obturator, sciatic, and linea alba.

a. *Inguinal.*—Inguinal bladder hernia is by far the most common variety and usually occurs in men. It is more frequent on the right side. Extra-peritoneal hernia in the inguinal region is usually direct if only the bladder is involved.

b. *Femoral.*—Femoral bladder hernia is much less frequent than inguinal. I found 79 cases of femoral hernia and 280 of the inguinal variety. Femoral hernia of the bladder almost always occurs in women and is most often on the right side; bilateral femoral hernia is very rare.

c. *Perineal.*—Bladder hernia through the perineum may be either anterior or posterior perineal; and it most frequently occurs in women, although a few cases have been observed in men. Harrington saw a case, in a woman, which was complicated by a large fibroid tumor.

d. *Obturator.*—Obturator hernia of the bladder is infrequent; only a few cases have been reported.

e. *Sciatic.*—Sciatic hernia of the bladder is very rare. An unusual case has been reported by Schreger, and another one by Burn.

f. *Linea Alba*.—Bladder hernia through the linea alba is infrequent and most often occurs in women. It may make its exit at any point in the lower third of the linea alba. Early cases were reported by Lichthien, LeDran, and Richter, but the findings were inconclusive. Gerulanos, in 1899 described

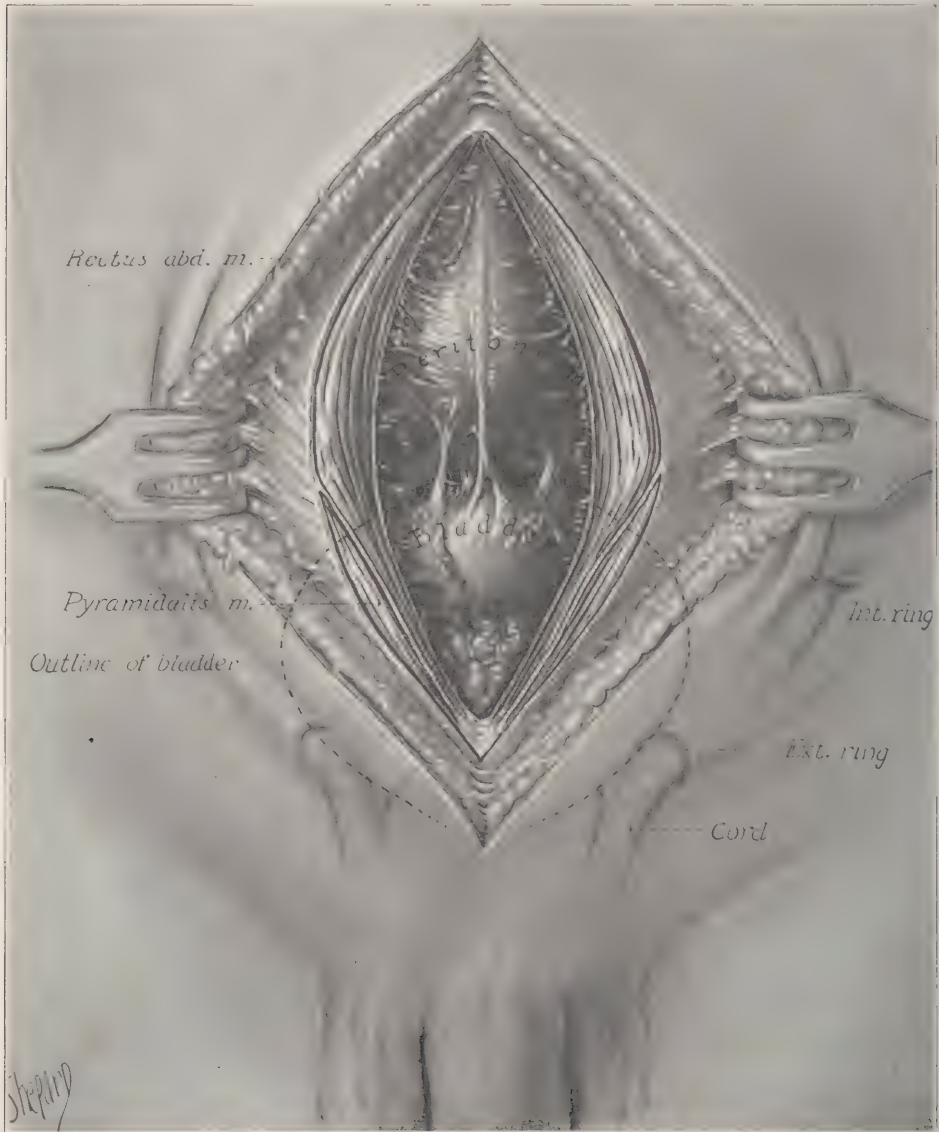


Fig. 217.—The relation of the bladder to the inguinal canal and rings. The normal position of the bladder is in the pelvis behind the pubes, and its relation to the hernial rings depends on the age and sex of the subject.

a bladder hernia through a separation in the linea alba; and Tédénat, in 1901, saw a woman 66 years old, with a suprapubic hernia of the bladder that had existed for 40 years. In both of these cases the hernia followed parturition.

Bilateral hernia is very rare. I collected 12 cases from the literature.

Pathology of the Bladder.—The normal position of the bladder is in the pelvis behind the pubes. It is situated in front of the rectum in the male, and in front of the cervix uteri and vagina in the female. The relation of the bladder to the hernial rings depends upon the age and sex of the subject, and the degree of distention present. A bladder must be abnormally large before a part of it can be forced into the hernial opening, or its attachments must be relaxed or a diverticulum must exist. (Fig. 217.)

The Hernial Sac.—The bladder may be outside the peritoneum, or it may be partially or wholly covered by it. In this respect, it differs from an enterocele which almost always has a true hernial sac. As first proposed by Jaboulay and Villard, bladder hernia is divided into three varieties, this classification depending on the relation of the peritoneum to the herniated bladder: Extraperitoneal, intraperitoneal and paraperitoneal. Primary vesical hernias may be extraperitoneal or paraperitoneal; while the secondary bladder hernias are either intraperitoneal or paraperitoneal.

a. *Extraperitoneal* (cystocele without serous sac—Duret).—While extraperitoneal cystocele is the rarest of the three varieties, it is probably more frequent than the number of reported cases indicate, because it produces no symptoms as long as the hernia remains small. It is always direct in the inguinal region, and as a rule, it is very small, although one the size of an orange has been reported. Moynihan remarks that a careful study has shown that many so-called “extraperitoneal hernias” have a small diverticulum whose outer wall of peritoneum is the inner covering of the sac and in reality, they are paraperitoneal hernias. Because extraperitoneal hernia lies entirely outside the sac, it is most liable to injury by being opened through mistake for the sac itself, especially if the operator has lost his landmarks and searches for the sac internal to the deep epigastric artery.

In inguinal hernia the anterior or lateral surface of the bladder, which is extraperitoneal, enters the canal first. The peritoneum entirely covers the superior surface of the bladder and is adherent to the lateral wall above and behind. As a rule, when there is a large amount of prevesical fat the peritoneum is easily stripped off the bladder. Aue reported a femoral extraperitoneal hernia, and Gladstone saw an obturator extraperitoneal hernia. (Figs. 218 and 219.)

b. *Paraperitoneal Hernia* (enterocystocele, with incomplete serous sac—Duret).—Paraperitoneal hernia is the most common of the three varieties. It has a sac, and may be direct or oblique. The bladder is on the inner side of the sac and the peritoneum of the inner wall of the sac is the serous covering of the outer portion of the bladder; the remainder of the bladder outside of the abdomen has no peritoneal covering. The bladder is outside of the peritoneal sac and not a part of the hernial contents. When peritoneal covered bladder descends into the sac, the peritoneum is adherent to it and closely follows it in its descent. The bladder is almost always found at the

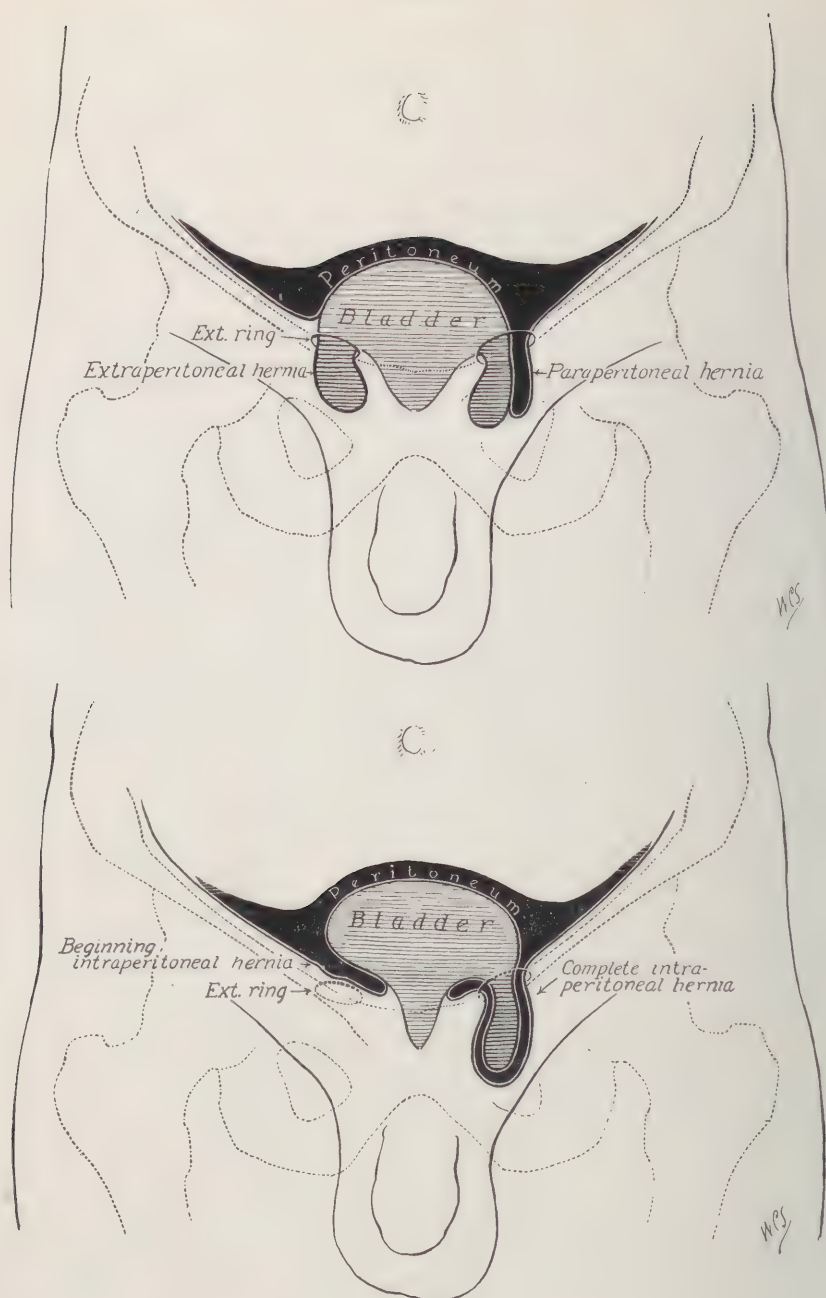


Fig. 218.

Fig. 219.

Fig. 218.—Extraperitoneal hernia of the bladder on the right side. It usually remains very small in size. In the inguinal region this variety is always direct. Paraperitoneal bladder hernia on the left side. This is the most frequent variety of bladder hernia.

Fig. 219.—Intraperitoneal hernia of the bladder. This variety is always secondary in origin and has a complete hernial sac.

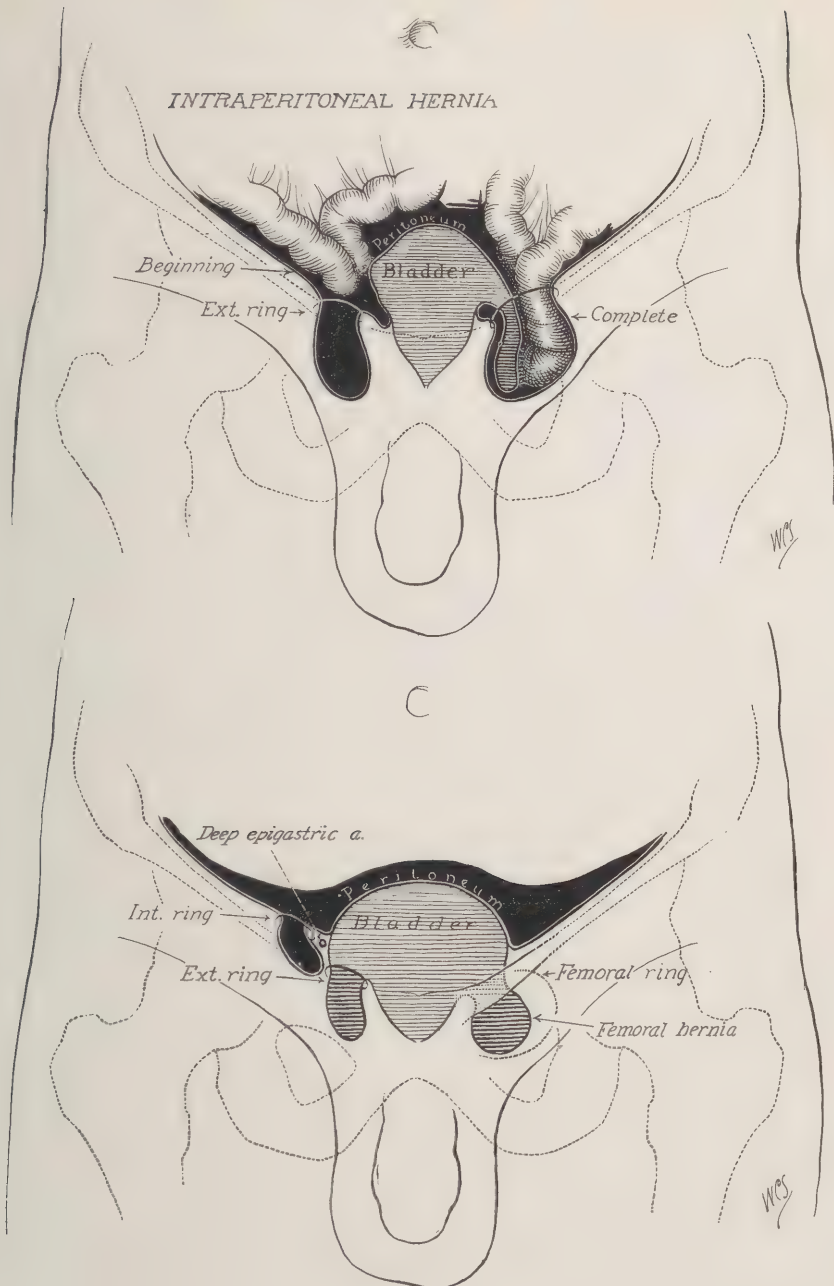


Fig. 220.

Fig. 221.

Fig. 220.—Hernia of the bladder. A beginning right oblique inguinal hernia. A complete left oblique inguinal hernia containing bladder and intestine. The bladder is intraperitoneal.

Fig. 221.—A right direct inguinal extraperitoneal hernia of the bladder and an empty peritoneal sac in the inguinal canal. A left extraperitoneal femoral hernia of the bladder.

inner and posterior part of the peritoneal sac. At operation, an apparent increase in the thickness of the sac is noticed, and dissection is more difficult on the inner side, which is the junction point of the peritoneal sac and bladder.

About 50 per cent of paraperitoneal hernias are thickly covered with fat (*Lipome herniaire* of Verdier). After freeing the cord and reducing the hernia, this mass is sometimes mistaken for a lipoma, a cyst of the cord or a second sac. The more careful the stripping of the sac up to the deep epigastric artery, the more chance there is of discovering cystocele in its early stages. In large hernia in elderly individuals, the normal bladder can often be drawn into the hernial wound without difficulty, owing to the relaxation of the peritoneum. A considerable proportion of paraperitoneal hernias are artificially produced at the time of operation. Imbert has termed these, "operative cystoceles."

c. *Intraperitoneal Hernia* (cystocele with intussusception of the bladder—Duret).—Intraperitoneal hernia is rare, but still occurs three times as often as the extraperitoneal variety, and is almost always of the inguinal type. It has a complete hernial sac that enters the inguinal canal external to the deep epigastric artery. The bladder enters this sac completely covered by peritoneum; the portion of bladder involved is almost always the upper part of the posterior surface. These hernias are sometimes very large and are always secondary in origin; the rings are widely dilated. The sac may contain only bladder, or omentum and intestine may be present also. (Figs. 220 and 221.)

4. **Frequency of the Varieties.**—Paraperitoneal is the most frequent variety of bladder hernia; extraperitoneal is next in frequency and intraperitoneal is the rarest of all. In 406 cases I found 204 paraperitoneal, 85 extraperitoneal and 17 intraperitoneal. (In the remainder of the cases the variety was not given.)

5. **The Hernial Contents.**—Bladder may be alone in the sac, or in addition to it small intestine and omentum are often found. In rare instances, one or more of the following viscera may be present with the bladder: Cecum and appendix, sigmoid, uterus, ovary and tube, prostate, ureters, and urachus. In the extraperitoneal variety, the bladder forms the hernial tumor and has no peritoneal sac.

In 47 cases of hernia of the ureter that I collected from the literature, the bladder was in the sac with the ureter in 16 cases.

a. *The Bladder.*—The amount of bladder in the hernia varies from a small portion of the anterior or lateral wall to the whole of the viscus; all of the bladder, excepting the trigone, has been found in a hernia by Guyon, Bonomo, Leroux, Harvie, and Beck.

I have seen a large inguinal hernia containing nearly all the small intestine, cecum and appendix, in addition to the bladder. Raymond observed a case of inguinal hernia in which the ovary, tube and bladder were present.

Hernias of the lower portion of the ureter and the whole of the bladder, with the exception of part of the trigone, have been reported, but they are very rare. Hernia of the isolated tube is very rare; it is usually of congenital origin, and the tube is often diseased. Guinard saw a case in which the ovary and bladder were in the sac, and Lejars observed a case of hernia of the fallopian tube and bladder. Jaboulay reported an unusual case in which the entire bladder and the prostate, which was as large as an orange, were found in the inguinal canal. Cases of calculi in the herniated bladder have been observed.

b. *Diverticulum of the Bladder*.—The portion of the bladder in the hernia is frequently a diverticulum; sometimes the opening connecting the herniated bladder with the pelvic bladder, is less than a quarter of an inch (6 mm.)

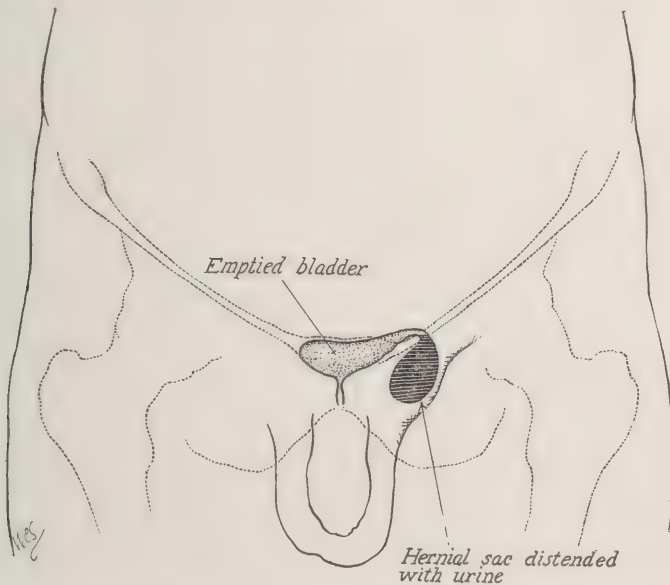


Fig. 222.—Hernia of the bladder with a narrow diverticulum connecting the cystocele with the pelvic portion of the bladder.

in diameter. (Fig. 222.) I believe the diverticula are usually congenital when the neck of the sac is very narrow and the walls are thin. Corner and Rowntree have reported the case of a boy, 18 months old, with tuberculosis in a diverticulum of the bladder, which was discovered during an operation for a congenital, irreducible, inguinal hernia. The interesting feature in this case is, that the child later developed a generalized tuberculosis of the peritoneum, which was subsequently cured by simply opening the abdomen and evacuating the fluid.

6. **Prehernal Lipoma**.—Prehernal lipoma was first observed by Verdier in 1753, and has been mentioned by many writers. It is a soft lumpy mass or a thickened layer in front of the bladder; or simply a collection of lemon-colored fat. I believe that the most striking feature of the lipoma is that it

is covered by a vascular network of vessels; when these are seen during the course of an operation, one may be sure that the bladder is nearby and should be on his guard. The bladder wall can be recognized by its color, vascularity and thickness.

Etiology

1. Predisposing Causes.—The most important causative factors of bladder hernia are age and sex. As early as 1753 Verdier observed that it usually occurred in old men. (It might also be said that anything that dilates the hernial rings or increases the volume of the bladder favors the incidence of this condition.)

a. *Age and Sex.*—Bladder hernia is primarily an affection of adult life and old age, though it has very rarely been found in young children. Adams saw it in a child of 18 months, and the patient reported by Corner and Rowntree was the same age. Wyeth's patient was two and a half years old; I found 30 cases in children under 12 years.

In 305 hernias of the bladder I collected from the literature, 204 were in men, and 101 in women. It was most frequent in men between 41 and 60 years of age, and in women between 31 and 50.

b. *Changes in the Bladder.*—Habitual overdilatation of the bladder and flaccidity favor bladder hernia. Dilatation may be due to prostatic disease, to obstruction in the urethra, or to a cystitis. When dilatation continues, there is deficient contractility of the bladder which is followed by muscular atony and flaccidity. The bladder remains permanently enlarged and overlies the hernial orifice, which it may enter, if the latter is widely dilated. In youth and early life, the abdominal muscles exert a restraining effect on the development of bladder hernia, and in old age when this restraint has given place to flabbiness, with the resultant relaxation of the hernial rings, conditions are favorable for the development of vesical hernia; especially so if there follows an exciting cause, such as an effort or strain. Many of these patients give a history of long-standing constipation, prostatic disease or cystitis.

c. *Relaxation of the Abdominal Wall.*—The relaxed abdominal wall is not only a predisposing cause of inguinal and femoral bladder hernia, but is also a factor favoring protrusions of the bladder through abnormal openings in the linea alba or muscular wall, such as occur in postoperative ventral hernia. The closure of the sac at the first operation draws the bladder toward the internal opening, and in case the hernia recurs, the bladder is liable to be one of the contents of the sac. Kummer has reported the case of a boy, aged 5 years, who had a recurrence after the radical operation, and at the second operation, the bladder was found in the sac. Gay found the bladder in an inguinal hernia sac while operating for recurrent hernia. I have seen a similar case. Clayton-Greene encountered the bladder in the sac at a secondary operation for femoral hernia in a woman. Bergener operated on a man with inguinal hernia, who had had an operation 4 years previous,

and the second operation revealed a bladder diverticulum, 2 inches (5 cm.) long.

d. *Congenital Predisposition*.—Congenital predisposition as a cause of bladder hernia was suggested in 1713 by Méry. It is probably a factor in a very small percentage of cases, as a large majority of the patients are adults or elderly before the hernia is noticed. It is probable that in some of the cases the bladder does not enter the sac, but there is a diverticulum which extends from the bladder through the hernial opening, and which in time may become enlarged, closely resembling a portion of the bladder proper. A few undoubted cases of congenital hernia have been reported: Hartmann saw a case in which the sac contained ovary, tube and bladder; Schreger observed sciatic hernia of the bladder in an infant one month old; Pott reported a case of inguinal hernia in a boy 6 years old; and Skeel diagnosed before operation, a femoral hernia that had been present since birth, in a girl, 5 years of age.

e. *Prevesical Lipoma*.—Although Verdier described prevesical lipoma, it was not until the studies of Monod and Delagénière that the subject received much attention. This mass of prevesical fat is adherent to the anterior portion of the bladder, and according to these authors, the bladder is drawn through the hernial orifice by the traction exerted by the lipoma. Another explanation is that the more fat there is, the easier it is to strip off the parietal peritoneum from the bladder, and with a well-defined lipoma, the bladder is loosely attached and it is easy for it to slip into a hernial opening. A prevesical lipoma or lipocoele was noted in 24 of the 180 cases collected by Brunner; in 110 cases collected by Eggenberger, a prevesical lipoma or a large mass of fat was present in 50 per cent.

f. *Traction of Enterocoele and Omentocoele*.—Secondary cystocoele may result from traction of a preexisting hernia or from the protrusion of a flaccid or distended bladder into an old or large hernial sac. This protrusion may be spontaneous, or the result of traction following intestinal or omental adhesions.

g. *Hernia of the Bladder in Women*.—Inguinal hernia of the bladder is much less frequent in women than in men (28 females to 203 males), while femoral hernia of the bladder almost always occurs in women (57 females to 6 males). The most important cause in women is pregnancy. During the early months of gestation the uterus does not exert much pressure on the bladder, but as the uterus changes it not only presses on the bladder but puts it on the stretch, causing it to change its shape. The pressure of the uterus on the ureter causes disturbances, and may favor retention of urine and distention of the bladder. The bladder may be irregular in shape and lie either behind or above the os pubis. Most of the cases have occurred in women who have had one or more pregnancies. (Fig. 223.)

Abdominal and pelvic tumors may change the relations of the bladder and cause atony and overdistention. Lejars reported a case of strangulated

right inguinal hernia in a woman; at operation it was found that a fibroid tumor had pushed the bladder into the inguinal canal.

Symptoms and Diagnosis

The symptoms of bladder hernia are often obscure. In some cases there is a large area of bladder involved and there are definite symptoms; but in



Fig. 223.—Femoral hernia of the bladder. When a large portion of the bladder is in the hernial sac the urine is often passed in two stages.

the majority of cases only a small portion of the bladder is affected and the typical symptoms are lacking. For this reason, 93 per cent of the cases that have been reported have been diagnosed at operation. The points of diagnosis can be conveniently divided into two groups—functional symptoms and physical signs:

1. Functional Symptoms.—The functional symptoms are chiefly disturbances in urination, such as frequent or involuntary micturition or urination in two stages—*miction en deux temps*. The patient first empties the pelvic portion of the bladder, then on pressing the tumor or assuming a peculiar position, the urine in the cystocele flows into the pelvic bladder and is voided. In the cases described by Petit and Justo, the patients had to lie down to empty the bladder. In Brodier's case, the hernia was very large and extended half way to the knees; in order for the patient to urinate, it was necessary for him to lift up the scrotum and compress it. De la Porte's patient with double bladder hernia was compelled to make pressure on both tumors before he could urinate.

Painful urination may be complained of, and can often be relieved by assuming certain positions; in rare instances, there may be hematuria. Pressure on the tumor is sometimes followed by a desire to urinate. In the case of femoral hernia of the bladder reported by Hertel and Hertel, the patient at times suffered severe pain radiating down the thigh as far as the inner side of the knee; the attacks lasted 2 to 3 hours and were usually relieved by urination. The bladder was dilated and the patient could retain the urine for 24 hours without discomfort.

2. Physical Signs.—A large or moderate-sized bladder hernia is generally smooth, rounded, fluctuating, and dull on percussion; the fluid often can be forced into the pelvic bladder by a recumbent position, or by firm and continued pressure over the tumor. If a hernial sac contains a bladder diverticulum, the opening connecting it to the pelvic bladder may be small and empty so slowly as to be unnoticeable. The hernia varies in size, being larger when the patient has retained the urine for some time, and smaller and softer after micturition.

Sometimes fluid can be felt in the mass, and there is an impulse on coughing. If bladder alone is in the hernial sac, the note on percussion will be dull; if intestine overlies the bladder, there is a tympanitic sound. In the inguinal variety the hernial opening is always large and out of proportion to the size of the enterocele. In enterocele the cord is intimately adherent to the sac; while in bladder hernia it is loosely attached and readily separated from the sac. The neck of the vesical sac is difficult to find, being covered by granular and very vascular fat; it is usually found near the pubes. Femoral bladder hernia in women usually becomes larger after each pregnancy, and may become permanently irreducible, due to the descent of the bladder on the outside of the sac.

Bladder hernia in men is often irreducible, especially if it is large and of the scrotal type. Sometimes the intestine and omentum in the sac can be reduced, leaving a firm mass, which, when lifted up with the fingers or compressed, becomes softer, and fluid can be felt flowing into the pelvic bladder.

Sometimes a sound or a catheter can be passed into the hernia and the tip of it felt just beneath the skin. The bladder can be inflated with air; if

the hernia contains bladder, it will increase in size, become tense, and give a tympanitic note on percussion. The injection of a fluid, preferably sterile normal salt solution, will increase the size of the tumor and make it more

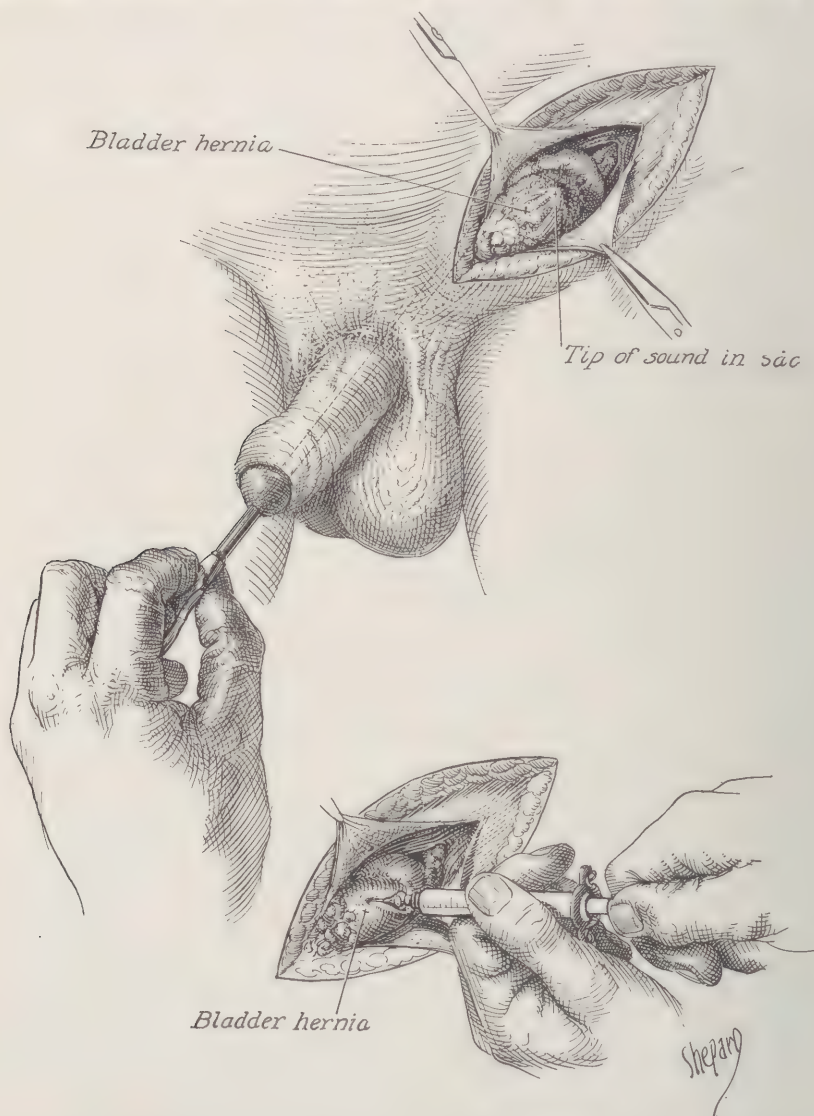


Fig. 224.—Recognizing the bladder during operation. A sound can be passed and the tip felt in the bladder hernia, or fluid can be safely aspirated with a fine needle inserted obliquely into the bladder wall. Testing with litmus paper will tell at once if it is urine. If this test is not possible a colored solution such as methylene blue can be injected into the bladder through a catheter before the bladder is aspirated.

tense. Cystoscopic examination will show a large internal opening if a part of the bladder wall is in the hernia; if it is a diverticulum of the bladder that is in the hernia, the opening into the pelvic bladder is very small. I was able to make a positive diagnosis in 2 cases, by cystoscopic examination.

The value of rectal examination is to be emphasized, the normal bulging of a distended bladder toward the rectum is absent in bladder hernia. If bladder hernia is suspected, methylene blue should be administered for a day before operation, then if the bladder is wounded the accident will be promptly recognized. (It might be added that with the preliminary administration of methylene blue, the simple aspiration of any suspicious-looking cystic tumor, by means of the hypodermic needle, will show a blue fluid if the tumor is the bladder.) (Fig. 224.)

Strangulated Hernia of the Bladder.—The greatest difficulty in diagnosis is encountered in those patients seen for the first time while suffering from strangulated hernia. The symptoms of bladder hernia that may have been present are masked by those of strangulation. A careful study of the history of the case may throw some light on conditions; and if the patient has had difficult or disturbed urination or if the symptoms have been relieved at other times by micturition, one should look for bladder involvement at operation. In rare instances, symptoms of bladder hernia simulating strangulation have been relieved when the patient voided and emptied the portion of bladder that had been pinched in the sac. Femoral vesical hernia may present no symptoms except frequency of urination, and change in the size of the tumor after voiding.

In the paraperitoneal variety, which is the most common form of vesical hernia, intestine and sometimes omentum are also strangulated. The symptoms of intestinal obstruction always overshadow the indefinite signs of bladder strangulation. It is only in the rare extraperitoneal form that the bladder alone constitutes the hernia, and when strangulated the diagnosis is problematic because the vesical symptoms are slight and the patient complains of pain over the whole abdomen. There is usually vomiting and some abdominal distention, and the hernia is tender, tense, and irreducible. Hutchinson's patient had severe abdominal pain and vomiting, with marked collapse; operation disclosed a nonstrangulated diverticulum of the bladder that was not covered by peritoneum. I collected from the literature 59 cases of strangulated bladder hernia. Of these, 29 were paraperitoneal, 11 extraperitoneal and 5 intraperitoneal. In 14 the variety was not given. Of 44 cases in which the result was given 37 recovered and 7 died—a mortality rate of nearly 20 per cent.

Calculi in the Herniated Bladder.—Stone in bladder hernia was frequently observed by the old writers, usually being discovered at autopsy. The first case was reported by Sala, in 1620, who sounded a man for stone but failed to find one. Later, at autopsy he found the stone in a pouch of the bladder in the inguinal canal in the sac of a hernia that also contained intestine. In the case reported by Pott, the stone caused signs of obstruction; in other instances inflammation was set up resulting in a urinary fistula and the calculi were extruded through the fistula, as in the case reported by Van de Wiel. Since the advent of the operation for hernia, these

cases are seldom seen. When the bladder is closed with nonabsorbable sutures calculi may form on the sutures, if they have been passed through the mucosa. Rougier observed a case of bladder hernia in which a vesical calculus was found at operation.

Differential Diagnosis

Hydrocele.—Hydrocele is not reducible and is translucent; while bladder hernia is not translucent and reduction can usually be accomplished, which is followed by a desire for urination.

Enterocoele.—Intestine in the hernial sac gives a soft elastic tumor which is tympanitic on percussion; it is nearly always reducible with a gurgling sound. Bladder hernia appears as a small hard tumor which is dull on percussion, and there are symptoms of disturbed micturition.

Omentocoele.—Omentum in a hernial sac presents a hard irregular mass which is insensitive to pressure. Pressure on the tumor does not cause pain referred to the bladder, or a desire to urinate.

Cysts of the Cord.—Encysted hydrocele of the cord or of the canal of Nuck is fixed in position or only slightly movable. There are symptoms of disturbed urination, and the tumor does not vary in size.

Prognosis

Hernia of the bladder does not jeopardize the life of the patient unless strangulation occurs, and this is unusual. His health may be impaired by the accompanying symptoms of frequent or involuntary urination and cystitis, which with the hernia aggravate a possible preexisting prostatitis. There is no expectancy of a spontaneous cure; the tendency is for the hernia to increase in size and the symptoms to become more severe.

If the hernia is reducible and there are decided contraindications to operation, a truss or bandage will give temporary relief. Operation is the treatment of choice, and the prognosis is good if the vesical hernia is diagnosed before operation or recognized before it is injured. In uncomplicated bladder hernia operations, there is a higher per cent of recurrence than in simple hernia operations, which is due to the difficulty of closing the large opening left by the bladder.

If the bladder is wounded, the prognosis is more serious even if the injury is recognized immediately and the opening closed. The most exact closure is not equal to the unwounded viscus. If the wound in the bladder is not diagnosed until after the operation, the outlook is very grave on account of the serious complications that may arise; namely, infection of the wound, leakage of urine into the peritoneal cavity with general peritonitis, extravasation into the subcutaneous tissues, and urinary fistula.

Out of 327 cases of bladder hernias in my series studied from a diagnostic standpoint, 25 were diagnosed before operation; 279 were diagnosed at operation, and 23 were not diagnosed until after operation.

In 241 cases collected by Eggenberger, the mortality was 6 to 16 per cent in those cases in which injury to the bladder was recognized at operation; and 30 to 40 per cent in the cases where the injury was not discovered until after operation. In the absence of an autopsy, death following operation may usually be attributed to bladder injury.



Fig. 225.—Operation for hernia of the bladder. Any thickening of the upper part of the sac, especially on the inner side, should be examined most carefully, vascular lemon-colored fat in this situation is pathognómonic of a prehernial vesical lipoma.

Treatment

Operation is the treatment of choice for hernia of the bladder. It is seldom possible for the patient to wear a truss with any degree of comfort or safety. When a vesical hernia is diagnosed or suspected before operation, preliminary treatment directed toward the bladder is advisable—internal antiseptics, bladder irrigations or instillations.

The danger of wounding the nonherniated as well as the herniated bladder during operation must always be borne in mind. Any thickening of the upper part of the sac, especially on the inner side, should be examined most carefully. The extraperitoneal variety (direct inguinal) is most liable to accident by being mistaken for a hernial sac and incised. (Fig. 225.) Griffith has described a pathognomonic sign of adherent bladder in hernia: He found the arched muscular fibers of the internal oblique, which ordinarily form the floor of the canal together with the conjoined tendon, closely attached to the sac. This sign was present in 3 cases.

The sac must not be stripped up if it covers a considerable portion of the bladder, but excision should be made around the bladder attachment, going as high as possible on the outer side where the sac is free. The bladder is loosened gently from its surroundings, in order to avoid tearing, returned to the abdomen, and the wound is closed by a circular suture or the pursestring method. (Fig. 226 and 227.) Beck reenforced this closure by suturing over it, a mass of fat secured from the properitoneal space. With the bladder safely out of the way, the radical operation can be done as far as conditions permit. When the internal oblique is insufficient to close the opening left by the bladder, it can often be closed with a flap taken from the rectus abdominis muscle and fascia.

After the neck of the sac is stripped up for resection, it should be freed of any thickening, and should not have an excess amount of fat attached to it. It should not be transfixed, ligated or excised until it is completely freed from all surrounding structures. Often the bladder is wounded because it is not seen. The greatest danger lies in cutting away a portion of it after it has been ligated *en masse* with the sac, and not discovering the accident until leakage of urine into the peritoneal cavity sets up a general peritonitis that may appear within a few hours after operation. Death has been known to occur within 24 hours after this accident.

When the bladder is wounded it usually happens when the operator is working under difficulties, perhaps away from a hospital, at times without an assistant, and with a poor artificial light making it difficult to dissect out the sac, and to identify the structures that may be adherent to it, and which would be promptly recognized under more favorable conditions.

How to Recognize the Bladder During Operation.—In case it is impossible to identify a suspicious tumor, the quickest way is to open the abdomen above the hernia and examine it from the inside. The hypodermic syringe has proven useful as an instrument of diagnosis. Fluid can be safely aspirated with a fine needle inserted obliquely into the bladder wall; testing with litmus paper will tell at once if this fluid is urine. This test should always be applied to any suspicious-looking cyst or hydrocele of the cord.

Sometimes the bladder may be recognized by the yellow prehernial fat or by the deeper color of the bladder wall, and the increased number of tiny blood vessels on its external surface. In direct inguinal hernia the neck

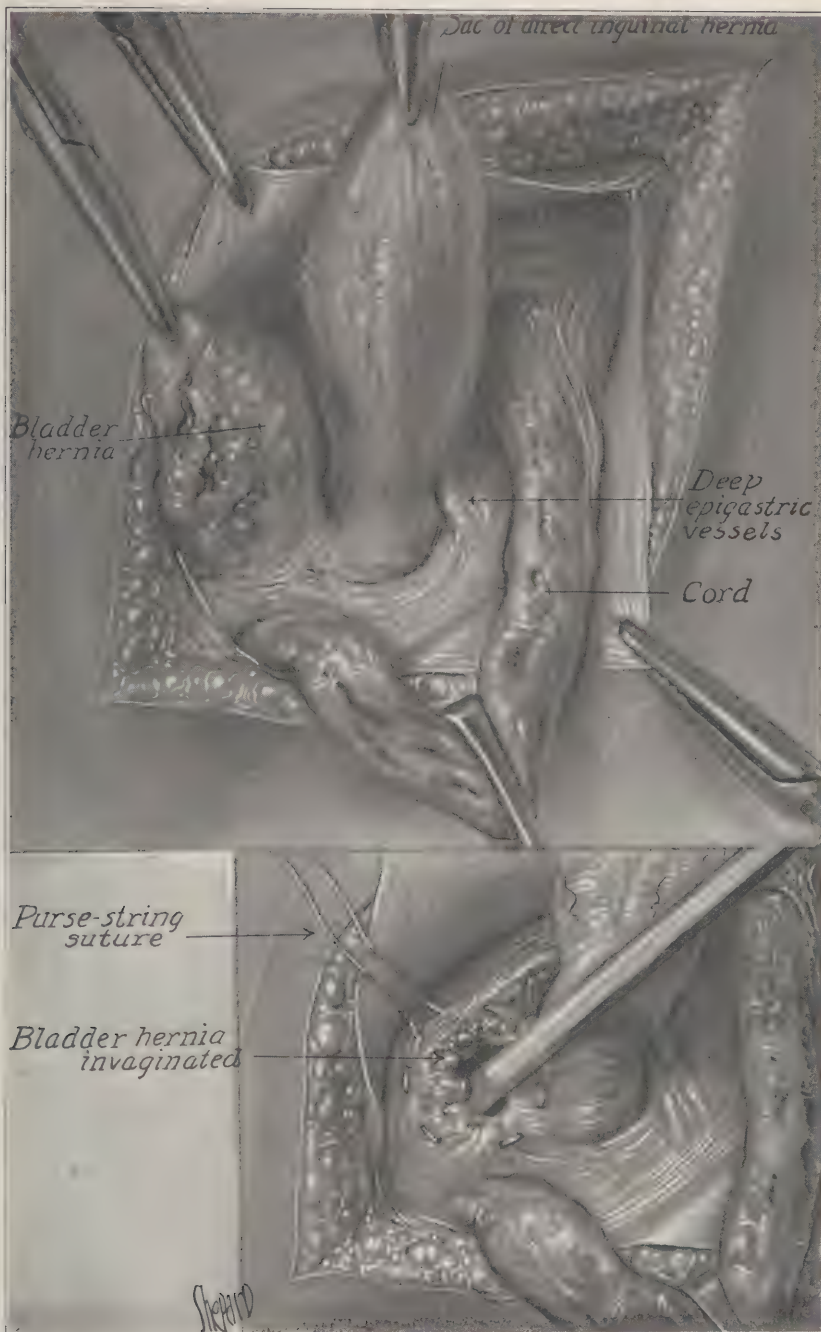


Fig. 226.—Operation for hernia of the bladder. The bladder is gently loosened from the direct hernial sac and cord structures. The bladder can be recognized by the yellow prehernial fat, by the deeper color of the bladder wall, and the increased number of tiny blood vessels on its surface.

Fig. 227.—The bladder is invaginated into the abdomen and the opening closed with a pursestring suture. The hernia is repaired by one of the methods described under the treatment of inguinal hernia.

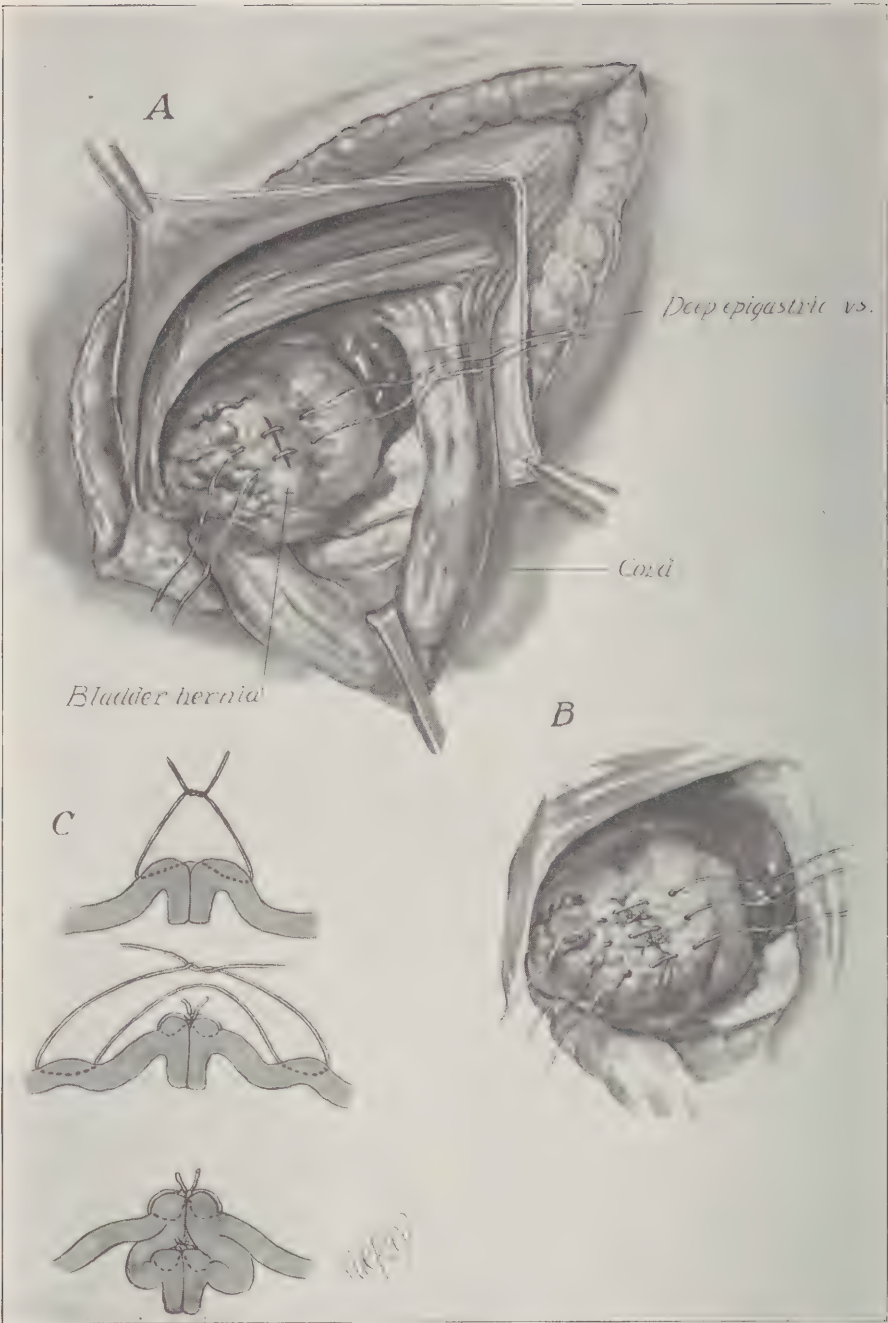


Fig. 228.—Operation for hernia of the bladder. When the bladder is wounded the tear or cut should be closed in two or three layers with interrupted sutures of chromicized catgut. No stitches should go through the mucosa, which should be inverted in closing. Non-absorbable sutures must never be used. (a) The first layer of Lembert sutures. (b) The second layer of Lembert sutures. A third layer should be inserted if the wound is large or if the peritoneal cavity has been opened. (c) Cross-section showing the layers of suture before and after tying.

of the sac will be internal to the deep epigastric vessels, and a globular swelling may appear on the inner side when the sac is opened. A sound can be passed and the tip felt in the bladder hernia; or the tumor can be distended by inflating with air, or by injecting fluid through the urethra. I have observed that during a hernia operation under local anesthesia if traction on the sac causes the patient to express a desire to urinate, it is a good sign that the bladder is nearby, usually adherent to the inner side of the sac wall.

What to Do If the Bladder Is Accidentally Wounded.—If the bladder is accidentally incised, it should be caught immediately with hemostats and a clamp placed across the opening. Compresses should be placed so that the urine will not contaminate the wound or reach the abdominal cavity. The tear or cut should be closed with interrupted sutures of chromicized catgut in two or three layers; no sutures should go through the mucosa, which should be inverted in closing. (Fig. 228.) The bladder is anchored in the lower part of the wound. The tissues that have been contaminated with urine are swabbed with iodine to produce adhesions and all dead spaces are carefully closed. A drain is inserted down to the bladder and allowed to remain for two or three days. A retained catheter is usually unnecessary, besides being the source of considerable discomfort; catheterization every four hours is sufficient. Argyrol should be kept in the bladder—just enough to disguise the bloody urine so that the patient is unaware of the accident.

If the bladder injury is not recognized for 12 to 36 hours after operation, the prognosis is grave. One should suspect vesical injury in the presence of frequent and painful urination, vesical tenesmus, bloody urine *per urethram*, or oozing through the dressings. If urine is entering the abdominal cavity the symptoms will be those of a fulminating general peritonitis. The wound must be opened immediately, the bladder injury found and sutured.

Strangulated Bladder Hernia.—Strangulated bladder hernia is a serious complication and calls for immediate operation. Fortunately it is rare, because hernia patients seek treatment nowadays before the hernia becomes large and irreducible.

The usual point of constriction is at the free edge of Gimbernat's ligament. Blakeway believes that the strangulation is usually due to the narrowness of the neck of the sac, and not to Gimbernat's ligament; and he urges division of the constricting neck of the sac from within its lumen. The gangrenous area of the bladder should be excised, and the edges sutured together and drains placed in the wound down to the bladder. If the bladder tissue is infected, or if it is the seat of malignant changes, or if a purulent cystitis is liable to prevent the sutures from holding, a cystotomy should be done by suturing the edges of the bladder wound to the skin and placing a drainage tube in the bladder.

Stone in the Bladder.—If calculi are discovered either in the bladder or in a diverticulum, which may be in the sac, an incision should be made through the vesical wall, the stones removed, and the bladder edges sutured.

Bibliography

HERNIA OF THE BLADDER

- ADAMS, C.: A case of vesical hernia in a child. *Clin. Rev., Chi.*, 1900, xii, 270-272.
- ARNAUD, G.: *Mémoires de chirurgie*. Lond., J. Nourse, 1768, i, 79.
- AUE, H.: Zur Frage über die Harnblasenbrüche. *Deutsche Ztschr. f. Chir.*, Leipz., 1892-1893, xxxv, 351-384.
- BECK, C.: Diverticulum of urinary bladder in an inguinal hernia. *Surg. Clin., Chi.*, 1919, iii, 1407-1409.
- BECK, C.: Gangrenous hernia of the bladder and intestines. *Surg. Clin., Chi.*, 1919, iii, 1411-1415.
- BERGENER, G. J.: Hernia of diverticulum of the bladder. *J. Am. M. Assn.*, Chi., 1912, lix, 540-541.
- BERGER, P.: Hernies de la vessie. In: *Traité de chirurgie*. Duplay, S., et Reclus, P. Paris, Masson, 1892, vi, 833-836.
- BLAKEWAY, H.: Hernia of the urinary bladder: Notes of cases, with remarks on strangulation of femoral herniæ and its treatment. *Lancet*, London, 1918, i, 799-800.
- BONOMO, L.: Sull' ernie della vescica; osservazioni anatomiche e contributo clinico di cura radicale. *Gior. med. d. r. esercito (etc.)*, Roma, 1898, xlv, 685-717.
- BRODIER: See Bourbon, H.: De la cystocèle inguinale rencontrée au cours de la kélotomie. Thèse, Paris, 1892.
- BRUNNER, F.: Ueber Harnblasenbrüche. *Deutsche Ztschr. f. Chir.*, Leipz., 1898, xlvii, 121-186.
- BURN: See Cooper, A. P.: p. 330-331.
- CARL, A.: Ueber die Harnleiterhernie. *Arch. f. klin. Chir.*, Berl., 1905, lxxvi, 1078-1099.
- CHRISTIAN: See Cooper, A. P.: p. 330.
- CLAYTON-GREENE, W. H.: Fatal injury to the bladder during an operation for femoral hernia. *Lancet*, Lond., 1907, ii, 1452.
- COLEY, W. B., AND HOGUET, J. P.: Operative treatment of hernia. *Ann., Surg., Phila.*, 1918, lxxviii, 255-268.
- COOPER, A. P.: Abdominal hernia. From the 2nd London ed., by C. A. Key. Phila., Lea & Blanchard, 1844.
- CORNER, E. M., AND ROWNTREE, C. W.: A case of tuberculosis in a diverticulum of the bladder found in an inguinal hernia. *Tr. Clin. Soc.*, Lond., 1906, xxxix, 21-25.
- DE LA BARRIÈRE, A.: De la cystocèle inguinale. Thèse, Paris, 1881.
- DE LA PORTE: See Verdier, C.: p. 22-23.
- DEMOULIN, A.: De le conduite à tenir dans les lésions opératoires (plaies, réséction) de la portion extrapéritoneale de la vessie (etc.), *Union méd.*, Par., 1893, 3. s., lvi, 325-333; 337-345.
- DIVOUX, J. P.: De hernia vesicæ urinariæ (1732). In: Haller. *Disputationes Chirurgicæ*. Lausannæ, Bousquet, 1755, p. 271-312.
- DURET, H.: Des variétés rares de la hernie inguinale. Thèse de concours, Paris, 1883.
- EGGENBERGER, H.: Harnblasenbrüche. *Deutsche Ztschr. f. Chir.*, Leipz., 1908, xciv, 524-579.
- FRANK, L.: Sliding hernia; With report of two cases involving the urinary bladder. *Am. J. Surg.*, N. Y., 1919, xxxiii, 49-55.
- FRELICH: Hernie crurale de la vessie. (Abstr.) *Gaz. d. hôp. de Toulouse*, 1896, x, 123-124.
- GAY, S. G.: Hernia of the urinary bladder. *Am. J. Surg.*, N. Y., 1918, xxxii, 301-303.
- GERULANOS, M.: Ueber Cystocèle linæ albæ. *Deutsche Ztschr. f. Chir.*, Leipz., 1899, liv, 191-201.
- GLADSTONE, R. J.: Obturator hernia of the bladder and of the Fallopian tube. *Ann. Surg., Phila.*, 1901, xxxiv, 796-807.
- GRIFFITH, J. D.: A pathognomonic sign of adherent urinary bladder in inguinal hernia. *J. Am. M. Assn.*, Chi., 1915, lxxv, 46.
- GUEPIN, A.: Cystocèle crurale. *Rev. de chir.*, Par., 1893, xiii, 646-659.
- GUETERBOCK, P.: Zur Kenntniss der Blasenhernien. *Deutsche Ztschr. f. Chir.*, Leipz., 1891-1892, xxxii, 296-318.
- GUINARD, U.: Hernie crurale droite étranglée; entéroccèle; cystocèle; présence de l'ovaire dans le sac. *Arch. gén. de méd.*, Par., 1896, i, 87-92.
- GÜNZ, J. G.: Observationum anatomico-chirurgicarum herniis libellus. Lipsiæ, J. C. Langenhemium, 1744.
- GUYON, J. C. F.: See Verdier, C.: p. 11-13.
- HARRINGTON, F. B.: Hernia of the bladder through the pelvic floor from the traction of a subperitoneal lipoma. *Tr. Am. Surg. Assn.*, Phila., 1900, xviii, 257-263.

- HARTMANN: See Jacobson, L.: Ueber den Mittelfleischbruch. *J. d. Chir. u. Augenh.*, Berl., 1826, ix, 393-433.
- HARVIE, J. B.: Hernial complications. *Am. Med.*, Phila., 1903, v, 532-533.
- HEDRICH: Remarques pratiques sur le diagnostic et le traitement de la cystocèle inguinale, rencontrée au cours d'une kélotomie. *Gaz. méd. de Strasb.*, 1890, xlix, 10-12; 13-19; 37-44; 67-70.
- HEINECK, A. P.: Hernias of the urinary bladder. *Surg. Gynec. & Obst.*, Chi., 1916, xxii, 592-602.
- HERTEL, A. L., AND HERTEL, G. E.: Hernia of the bladder into the femoral canal, with a review of the diagnostic points of femoral hernia and the report of an interesting case. *Therap. Gaz.*, Detroit, 1912, xxxvi, 766-770.
- HUTCHINSON, J. JR.: Diverticulum of the bladder in a femoral hernia without a sac; operation. *Lancet*, Lond., 1907, ii, 1382.
- HUTCHINSON, J.: Hernia and Its Radical Cure. London, Henry Frowde and Hodder & Stoughton, 1923.
- IMBERT, L.: Cystocèle inguinale. *Bull. Soc. anat. de Par.*, 1896, lxxi, 168-170.
- JABOULAY, M., AND PATEL, M.: Hernies. XXV. Nouveau traité de chirurgie. Le Dentu, A. et Delbet, P. Paris, J. B. Baillière, 1908.
- JABOULAY AND VILLARD: Des hernies inguinales et crurales de la vessie. *Lyon méd.*, 1895, lxxviii, 239-254; 281-293.
- JUSTO, J. B.: Sobre la curación radical de la hernia de la vejiga. *Rev. Soc. méd. argent.*, Buenos Aires, 1892, i, 201-210.
- KRÖNLEIN, R. U.: Herniologische Beobachtungen. Hernia intestino-vesicalis serotalis incarcerata. *Arch. f. klin. Chir.*, Berl., 1875-1876, xix 420-427.
- KUMMER, E.: Hernie vésicale découverte au cours de l'opération radicale d'une hernie inguinale. Laparotomie, guérison. *Rev. méd. de la Suisse Rom.*, Genève, 1892, xii, 235-240.
- LANZ, O.: Ueber crurale Blasenhernie. *Berl. klin. Wehnschr.*, 1892, xxix, 741-743; 777-780.
- LE DRAN, H. F.: Traité des operations de chirurgie. Paris, C. Osmont, 1742, p. 135.
- LEJARS, F.: Hernie inguinale simultanée de la trompe utérine et de la vessie, les hernies de la trompe, les lésions opératoires de la vessie herniée. *Rev. de chir.*, Par., 1893, xiii, 111-138.
- LEROUX, C.: Note sur la cystocèle inguinale. *Rev. mens. de méd. et de chir.*, Par., 1880, iv, 367-386.
- LICHTHIEM: See Berger, P.: p. 833.
- LUCAS-CHAMPIONNIÈRE, J.: La cure radicale de la hernie inguinale. Paris, G. Steinheil, 1909.
- MÉRY, J.: Observations sur différentes maladies. *Mém. Acad. roy. d. sc.*, Par., 1713, p. 112.
- MONOD, C., AND DELAGÉNIÈRE, H.: La cystocèle inguinale. *Rev. de chir.*, Par., 1889, ix, 701-727.
- MORIN, J. A.: Étude de la cystocèle crurale. Thèse, Paris, 1897.
- MOYNIHAN, B. G. A.: The anatomy and pathology of the rarer forms of hernia. Arris and Gale lectures. Lecture 3: Hernia of the bladder. *Lancet*, Lond., 1900, i, 596-601.
- NÉLATON, A.: Eléments de pathologie chirurgicale. Paris, Baillière, 1859, v, 441.
- OLIVA, C.: L'ernia della vescica nell'infanzia. *Arch. Ital. d. Chir.*, Bologna, 1923, vi, 533-564.
- PETIT, J. L.: Les hernies de vessie peuvent avoir des causes accidentelles. *Mém. Acad. roy. d. sc.*, Par., 1717, p. 14.
- PIPELET, LE JEUNE: Nouvelles observations sur les hernies de la vessie et de l'estomac. *Mém. Acad. roy. de chir.*, Par., 1768, iv, 181-200.
- PIQUET, C.: Contribution à l'étude de la cystocèle inguinale. Thèse, Paris, 1893.
- PLATER, F.: Observationum libri tres totidem praxeos tractatibus. Basileæ, J. L. Koenig, 1680, iii, 830-832.
- POTT, P.: An account of a hernia of the urinary bladder, including a stone. *Phil. Tr.*, Lond., 1764, liv, 61-64.
- REYMOND, E.: Hernie inguinale de la vessie, de la trompe et de l'ovaire. *Bull. Soc. anat. de Par.*, 1894, lxi, 842-844.
- RICHTER, A. G.: Abhandlung von den Brüchen. Göttingen, J. C. Dieterich, 1785, p. 760-786.
- ROUGIER: Volumineuse hernie de la vessie renfermant un calcul. *J. d'urol. méd. et chir.*, Par., 1917-1919, vii, 587-588.

- RUYSCH, F.: *Observationum anatomico-chirurgicarum*. Amstelodami, Henricium Viduam et Theodori Boom, 1691, p. 125-126.
- SALA, J. D.: See Verdier, C.: p. 11.
- SANDIFORT, E.: De hernia vesicæ vaginali. *In his: Observationes anatomico-pathologicae*. Lugduni, Eyk et Vygh, 1777, i, 55-64.
- SCHOONEN: Cystocèle crurale. *Rev. de chir., Par.*, 1893, xiii, 331-332.
- SCHREGER, B. N. G.: *Chirurgische Versuche*. Nürnberg, J. L. Schrag, 1818, ii, 167-179.
- SKEEL, R. E.: Injuries to the bladder during hernia operations. *Am. J. Obst., N. Y.*, 1908, lviii, 964-970.
- TYDÉNAT, E.: Hernies vésicales de la ligne blanche. *Bull. et mém. Soc. de chir. de Par.*, 1901, n.s., xxvii, 294-300.
- VAN DE WIEL, S.: See Verdier, C.: p. 14.
- VERDIER, C.: Recherches sur la hernie de la vessie. *Mém. Acad. roy. de chir., Par.*, 1753, ii, 1-58.
- VERDIER, LE SECOND: See Jaboulay, M. et Patel, M.: p. 400.
- WYETH, J. A.: Strangulated oblique inguinal hernia of the right side in a child two and one-half years of age, with the bladder imprisoned in the hernial sac and inguinal canal. *Arch. Pediat., N. Y.*, 1895, xii, 205-206.

CHAPTER XXVII

HERNIA OF THE URETER

Synonym.—Ureterocele.

Definition.—A hernia of the ureter is a protrusion of the ureter through a normal or abnormal opening in the abdominal or pelvic wall.

Hernia of the ureter is very rare, and only a few cases have been reported in the literature. Harris observed the following case which has not been reported: A man, aged 53, presented a right inguinal hernia of two years' standing. On examination, a lipomatous mass twice the size of a hen's egg was found in the right inguinal region, but it did not extend into the scrotum. At operation under local anesthesia, the mass was found to

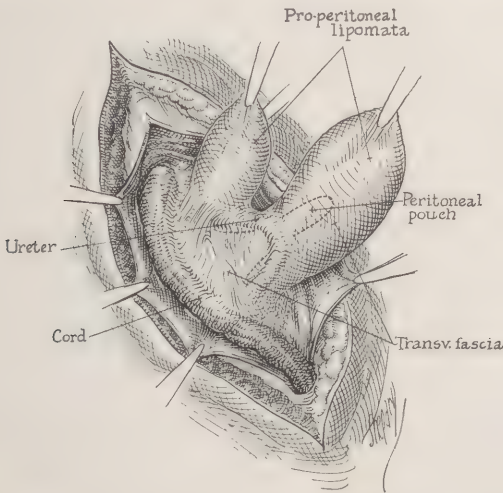


Fig. 229.—Inguinal hernia of the ureter (Courtesy of Dr. M. L. Harris).

consist of two distinct parts. The smaller part which measured $1\frac{2}{5} \times 3\frac{1}{5}$ inches (4 by 8 cm.) was just to the inner side of the cord, and the larger part which measured $2\frac{2}{5} \times 4$ inches (6x10 cm.) lay to the inner side of the small one. The fat was thickest on the inner side of the sac, and traction on it pulled on the bladder. The right ureter looped down on the outer and anterior surface of the inner mass and was partly embedded in fat. The lipoma and sac were excised, the ureter and protruding bladder returned to the abdomen, and the hernial opening repaired. The patient made an uneventful recovery. (Fig. 229.)

Important papers on hernia of the ureter have been published by Reichel, Rolando, Carli, Meissner, Brunner, Caccia, Berti, and Dardanelli.

In 1923 I collected from the literature 47 cases of hernia of the ureter.

	MALES	FEMALES
Right inguinal	21	3
Left inguinal	3	2
Right femoral	1	12
Left femoral	0	3

(In one inguinal hernia of the ureter, the sex or side was not given; in one femoral hernia in a female the side was not stated.)

RELATION TO PERITONEUM

Paraperitoneal	34
Extraperitoneal	3
Not stated	10
Bladder also in hernia	16

Anatomy

The ureter in a hernia is usually normal in appearance, and is especially likely to be so, when it accompanies the bladder into the sac. The ureter is nearly always found in contact with a good-sized mass of fat.

Anatomical Varieties.—There are two anatomical varieties of hernia of the ureter:

1. The paraperitoneal variety, in which the hernia has a peritoneal sac.
2. The extraperitoneal variety in which the sac is absent. In both varieties the ureter may be alone, or it may be accompanied by the bladder.

As a rule, the ureter lies behind the sac, and accompanies a hernia of the intestine or omentum.

Clinical Varieties.—From a clinical standpoint, hernia of the ureter is divided into two varieties:

1. Hernia of the ureter alone.
2. Hernia of the ureter associated with other viscera, usually with the bladder.

Brunner observed an isolated hernia of the ureter in which the loop was 8 inches (20 cm.) long.

Etiology

Practically all of the recorded cases of hernia of the ureter have been caused by the ureter sliding into the sac, in very much the same manner that a sliding hernia of the large intestine slips into the sac. It is very difficult to produce hernia of the ureter experimentally on the cadaver; it is much easier to make the ureter enter the femoral canal than the inguinal canal.

As a possible cause of hernia of the ureter, Reichel suggested the possibility of the formation of adhesions between the ureter and testicle during intrauterine life, which might result in the ureter being carried into the inguinal canal. (No case of this type has been reported.)

Extraperitoneal hernia of the ureter is probably congenital. The paraperitoneal variety may be due to an unobliterated peritoneal process which draws the ureter into the hernial canal either by traction on underlying tissues, or as a result of adhesion of the ureter to the posterior wall of the sac. When the portion of the bladder adjacent to the ureter is in the sac, it is usually due to traction exerted by the ureter.

Age.—A majority of cases of hernia of the ureter have been observed in subjects between 40 and 60 years of age.

Sex.—Hernia of the ureter occurs in both sexes with about equal frequency. Of 47 cases I collected from the literature, 21 were in females and 25 in males and in 1 the sex was not given.

Site.—Hernia of the ureter most often occurs in the inguinal region. I found 29 of the inguinal to 16 of the femoral variety. The inguinal variety nearly always occurs in men, and the femoral in women. Only 5 cases of inguinal hernia of the ureter have been observed in females, and only 1 case of the femoral variety in males.

Hernia of the ureter alone is most frequently femoral, while hernia of the ureter and bladder is usually inguinal. Gelpke observed the only case of femoral hernia of the ureter and bladder that has been reported.

Symptoms

There are no characteristic symptoms of hernia of the ureter, and none of the reported cases have been diagnosed prior to operation. Sometimes there is a history of disturbances in urination. The patient observed by Ross and Taylor had had frequent micturition for two years. Rarely there may be hematuria, and pain in the lower abdomen or lumbar region if there is a complicating hydronephrosis. The possibility of hernia of the ureter should be thought of when there is a hard, cord-like, incompletely reducible mass in the hernial canal, especially if it is associated with an empty sac. When the loop of ureter in the hernia is very much dilated, the cystic tumor is dull on percussion, there is no gurgling when it is reduced, and sometimes the fluid can be felt as it is forced out of the dilated loop. Pressure of a truss pad on the ureter may result in a lessening of the quantity of urine voided, and the removal of the pressure is followed by an increase in amount.

Cystoscopic examination and catheterization of the ureter offer the best prospect for a preoperative diagnosis. When ureteral catheterization is possible, an obstruction is encountered in the region of the hernia. If the catheter passes through the herniated loop, it reenters the abdomen, and in case

of hydronephrosis a large amount of urine is evacuated. Roentgen-ray examination, with the catheter in the ureter, will enable the examiner to make a positive diagnosis of hernia of the ureter. In the cases reported by Reichel, and Meissner, catheterization of the ureter was impossible on account of stenosis. Hydronephrosis as a complication of hernia of the ureter is not common.

Differential Diagnosis

Hernia of the ureter must not be mistaken for hernia of the appendix, hernia of Meckel's diverticulum, bladder diverticulum, hydrocele of the cord, adherent omentocele, or enterocele.

Treatment

If the ureter is identified before it is wounded, it should be freed and returned to the abdominal cavity. In femoral hernia identification is usually very difficult. If the presence of the ureter is suspected, the operator should make an inguinal incision and look for the remains of the umbilical artery, and in females, for the round ligament also. In order to reduce femoral hernia of the ureter, it is sometimes necessary to cut Poupart's ligament.

If the ureter is wounded, it should be repaired by longitudinal or transverse interrupted sutures. When it has been completely divided, the ends may be united by end-to-end anastomosis, or by one of the methods used in general surgery for wounds of the ureter; or the distal end can be implanted into the bladder. (See accidents of inguinal hernia operations.)

Caccia stated that implantation into the bladder is indicated when the ureter is considerably dilated and has lost the power of contraction. Rolando believed that implantation should always be done when hernia of the ureter is complicated by a hernia of the bladder. When the ureter is thick, dilated or when it cannot be replaced in the abdominal cavity, resection of a portion of it is indicated.

If the ureter is dilated, stenosed or diseased, the kidney on the affected side should always be examined for hydronephrosis, and if it is extensively involved, it should be removed; provided, of course, that the operator is certain the other kidney is normal. If a fistula develops following a wound of the ureter, a second operation will be required to implant the ureter into the bladder. In Meissner's case, resection of the ureter was necessary because of the stenosis.

Bibliography

HERNIA OF THE URETER

- BERTI, G.: Un caso di ernia crurale dell' uretere. *Pensiero med.*, Milano, 1911, ii, 208-210.
- BRUNNER, F.: Descensus des rechten Ureters ins Scrotum, eine Hernia inguino-scrotalis vortauschend. *Deutsche Ztschr. f. Chir.*, Leipz., 1907, xc, 275-281.
- CACCIA, F.: L'uretérocele, con speciale riguardo alla sua patogenesi; contributo clinico, anatomico e sperimentale. *Arch. ed atti d. Soc. ital. di chir.* 1908, Roma, 1909, ii, 309-441.

- CARLI, A.: Ueber die Harnleiterhernie. Arch. f. klin. Chir., Berl., 1905, lxxvi, 1078-1099.
- DARDANELLI, M.: L'ernia dell' uretere con speciale riguardo alla sua patogenesi. Clin. chir., Milano, 1910, xviii, 769-882.
- GELPKE, L.: Gangränöse Hernien, Behandlung derselben durch Resection mittelst Murphyknopf—oder Einstülpung und Darmaht. Cor.-Bl. f. schweiz. Aerzte. Basel, 1897, xxvii, 265-267.
- HARRIS, M. L.: Personal communication, 1922.
- MEISSNER: Der Ureter als Inhalt eines Leistenbruchs. Beitr. z. klin. Chir., Tübing., 1907, liv, 712-722.
- REICHEL, P.: Ueber hernienartigen Vorfall eines Ureters durch den Leistenkanal. Arch. f. klin. Chir., Berl., 1892, xlv, 430-437.
- ROLANDO, S.: Contributo all' ernia dell' uretere. Riforma med., Palermo-Napoli, 1904, xx, 566-568.
- ROSS, G. G. AND TAYLOR, K. P. A.: Sliding hernia of the ureter. Ann. Surg., Phila., 1921, lxxiii, 613-620.

CHAPTER XXVIII

HERNIA OF THE OVARY, FALLOPIAN TUBE AND UTERUS

Synonyms.—Hernia of the ovary: Hernia ovarialis; Ovariocele; Oöphorocele.

Hernia of the fallopian tube: Tubal hernia.

Hernia of the uterus: Hysterocele; Hernia uteri.

Definition.—A protrusion of the ovary, fallopian tube or uterus through a normal or abnormal hernial opening.

The internal genital organs of the female found in hernial sacs in the order of their frequency are as follows: The ovary and tube, the ovary, the tube without the ovary, next the nongravid uterus; and, least often, is hernia of the pregnant uterus. Since herniotomy has become a common procedure, abnormal contents of the sac are being found with increasing frequency.

Historical

Ovary and Tube.—The first case of hernia of the ovary is reported in the writings of the Greek physician Soranus, of Ephesus, about 97 A. D. "Some, as is claimed by Chios, say that there are also suspensory ligaments attached to the ovaries. We ourselves have verified this fact by experience in the case of a woman affected with intestinal hernia; with that woman there occurred, during the operation a prolapse of the ovary following the relaxation of the vessels that retained and enveloped it and with it the suspensory ligament also escaped."

Although there is no record of hernia of the ovary, tube and uterus in literature for the next fifteen hundred years following this early report, it probably occurred just as frequently as it does today. The first authentic record of hernia of the internal genitalia is Pol's case reported in 1531, of hernia of the pregnant uterus, and a similar one observed by Sennertus in 1610. The first mention of hernia of the fallopian tube was probably made by Lavater, in 1672. The next case was reported in 1716, when de Gouey observed a large hernial tumor which was probably one of ectopic gestation.

Deneux, in 1813, collected from the literature 12 cases of hernia of the ovary; 9 of these were inguinal. He believed that hernia of the ovary was always accompanied by the tube and was of congenital origin. Loumagne, in 1869, was able to find records of 15 cases of hernia of the ovary and tube. The following year Hamilton reported 12 new cases of hernia of the ovary. In 1868 Englisch found in the literature 38 hernias of the ovary; 27 of these were inguinal. Seven years later Puech collected 65 cases of congenital in-

guinal hernia of the ovary, and in 1879 he was able to find a total of 106 cases. By this time hernia of the ovary was not regarded as a rare condition, but as one to be looked for.

Important papers on the pathology of hernia of the ovary were published by Wibaille in 1874, Barnes in 1883, Thomas in 1887, and Brunner in 1889. Lejars, in 1889, wrote on the diseases of the herniated ovary, and in 1893 he was able to collect from the literature 8 cases of hernia of the tube alone, and added one he had observed himself; of the 9 cases, 4 were inguinal. In 1894 Manega reported 5 cases of inguinal hernia of the ovary; in 1 of these the ovary was alone in the sac with the intestine; and in the remaining 4 cases the ovary and tube alone were in the sac. Mencière, in 1897, wrote on hernia of the ovaries in infants; and in 1901 Morf collected from the literature the cases of hernia of the tube alone. Garrigues, in 1904, was able to collect from the literature 43 cases of isolated hernia of the tube. Costa, in 1912, wrote an interesting paper on the anatomy of hernia of the ovary and tube. In 1920 Vas observed an unusual case of retrograde strangulation of the fallopian tube; and in 1922, Birmann pointed out the dangers of rupture of the strangulated fallopian tube from ill-advised attempts at taxis.

The Uterus.—In 1610 Sennertus reported 2 cases of inguinal hernia of the pregnant uterus. From a careful study of all available records, I believe that one of these 2 cases is the same as the case previously observed by Pol (1531) and that it is simply reported again by Sennertus. The occurrence of hernia of the uterus with one tube and ovary was mentioned by Boyer, in 1822, by Boivin and Dugés in 1834, and Cormack, in 1841. Eisenhart, in 1885, made a thorough study of 12 cases of hernia of the uterus that he was able to collect from the literature. An important paper by Adams appeared in 1889. Küstner, in 1897, was able to find 15 cases in the literature, and Hilgenreiner, in 1906, collected 8 additional cases. Other papers on hernia of the uterus were published by Schwartz, in 1892; Legueu, in 1897; Boeckel, in 1892; Bordeau, in 1905; Ogé, in 1900; Jopson, in 1904; and Birnbaum, in 1905.

Andrews, in 1906, was able to collect from the literature 43 cases of hernia of the nongravid uterus, and 30 cases of hernia of the pregnant uterus. In 1908 Cranwell collected from the literature, 64 cases of hernia of the uterus. Farrar, in 1912, in a study of hernia of the uterus with both adnexae, found 3 of the femoral and 23 of the inguinal type. Hewitt in 1923, reported a case of inguinal hernia of the uterus and both adnexae.

Statistics

In 1923 I collected from the literature 175 cases of hernia of the ovary and tube; 156 cases of hernia of the ovary alone; 68 cases of hernia of the tube alone; 58 cases of hernia of the nonpregnant uterus; and 30 cases of hernia of the pregnant uterus.

Sex and Site.—In 487 cases the sex of the patient or the site of the hernia, or both, were given as follows:

	SIDE NOT GIVEN		INGUINAL				FEMORAL				OTHER VARIETIES	TOTAL CASES	
			R.	L.	BILAT.	SIDE NOT GIVEN	R.	L.	BILAT.	SIDE NOT GIVEN			
	R.	L.											
Ovary and tube	6	1	54	71	8	10	7	4	0	1	Obturator sciatic perineal	9 2 2	175
Ovary alone			49	27	17	41	10	7	1	4		1	156
Tube alone			21	14	1	5	13	4	0	3	obturator	7	68
N o n - gravid uterus			13	26	4	9	4	2					58
Gravid uterus			6	7	0	1	0	1			ventral umbilical	10 5	30

Age.—The age was given in 427 patients as follows:

	OVARY AND TUBE	OVARY ALONE	TUBE ALONE	NON-GRAVID UTERUS WITH OVARIES OR TUBES	GRAVID UTERUS
Under 1 year	54	63	10	12	
1 to 2 years	11	2	1	0	
2 to 10 years	10	10	0	0	
11 to 20 years	12	16	2	4	1
21 to 30 years	17	16	9	10	5
31 to 40 years	27	25	13	6	6
41 to 50 years	12	13	9	6	4
51 to 60 years	4	6	7	1	
61 to 70 years	6	2	3	3	
71 to 80 years	1	2	3	0	
81 to 90 years	1	0	0	2	
Total	155	155	57	44	16

Treatment

The result of treatment was given in 347 cases as follows:

	TOTAL CASES	EXCISION		REDUCED		OPERATION	
		R.	D.	R.	D. *	R.	D.
Ovary and tube	144	86	7	44	1	6	0
Ovary alone	134	57	0	75	0	2	0
Tube alone	27	20	3	0	0	4	0
Non-gravid uterus (usually one cornu) ovar- ies or tubes	42	15	0	19	1	7	0
	347	178	10	138	2	19	0

In 56 cases of hernia of the non-gravid uterus the sac contents were as follows:

Uterus alone in sac	6
“ and one ovary	7
“ “ two ovaries	1
“ ovary and tube	23
“ two ovaries and two tubes	14
“ and tube	3
“ “ two tubes	2

In 18 cases the uterus was rudimentary or only one cornu was in the hernial sac.

Hernia of the Pregnant Uterus.—In 13 cases the time the uterus entered the hernial sac was given.

Before conception	2
At the 3rd month	4
At the 6th month	1
At the 7th month	2
At the 8th month	2
At the 9th month	2

In 10 cases delivery was by normal labor, the gravid uterus usually being reduced within the abdomen.

In 3 cases the herniated uterus was emptied by operation at the 3rd, 4th, and 5th months respectively. In one case premature labor was induced at the 7th month and in another at the 8th month. In 7 cases the child was delivered by hysterotomy. In 26 cases the mother survived in 20, and died in 6. In one ventral hernia the uterus was in the hernial sac from the 3rd to the 12th labor. In two other cases it was in a ventral hernial sac during two pregnancies.

Pregnant Uterus with Ovary and Tube.—The pregnant uterus was alone in the sac in 23 cases, with the ovary and tube in 3, and with the ovary in 3.

Anatomy

1. The Site of Hernia of the Ovary and Tube.—

a. *Inguinal.*—Ninety per cent of the hernias of the ovary and tube are of the inguinal variety. The hernia is most frequently on the left side; it is rarely bilateral. I found 8 cases of bilateral hernia of the ovary and tube, 17 of the ovary alone, and 1 of the tube alone. (Fig. 230.)

b. *Femoral.*—In 17 cases of hernia of the ovary and tube I found 12 femoral; in 156 cases of hernia of the ovary alone 22 were femoral; and in 68 cases of hernia of the tube alone, 20 were femoral. Of these 54 cases of femoral hernia, only one was bilateral.

c. *Obturator.*—Obturator hernia of the ovary and tube is infrequent. I found only 9 cases, and 7 of hernia of the tube alone.

d. *Sciatic.*—Sciatic hernia of the ovary and tube is very rare. I found

only 2 cases. The first one was reported by Camper, and the second, by Chénieux; in the latter case a large ovarian tumor was found.

2. **The Site of Isolated Hernia of the Tube.**—Hernia of the tube alone is rare. I have been able to collect in the literature only 68 cases.

a. *Inguinal.*—A majority of the hernias of the tube alone are of the inguinal variety. I found only one case of bilateral inguinal hernia of the tubes alone.



Fig. 230.—Inguinal hernia of the ovary and tube.

b. *Femoral.*—Of 68 cases of hernia of the fallopian tube alone, 20 were femoral.

c. *Obturator.*—Of the 68 cases of hernia of the fallopian tube alone, 7 were obturator. Chiene observed a bilateral obturator hernia of the tubes alone.

3. **The Site of Hernia of the Uterus.**—Hernia of the non-gravid uterus is almost always inguinal. Hernia of the pregnant uterus is either inguinal femoral, umbilical, or ventral.

4. The Hernial Contents.—

1. *Hernia of the Ovary and Tube*.—Inguinal hernia of the ovary without the tube is infrequent; in the femoral variety, the ovary is often not accompanied by the tube. Hernia of the ovary and tube is the most frequent variety. Most of the cases occur in children under two years old. The ovary or tube may be in the inguinal canal, or outside the external inguinal ring with equal frequency, but when intestine is present in the sac, the ovary is outside the ring. In some cases the ovary is accompanied by intestine; in a majority the ovary and tube are the sole contents of the sac. Cruveilhier believed that the hernia of the tube preceded that of the ovary. Dolbeau accepted this theory; while Lockwood stated that the ovary was always in front and below the tube. The later observations of Wiart prove that the ovary and tube have no definite position. Omentum may be present in the sac, especially if the hernia is inguinal or umbilical. The cecum, appendix and bladder have also rarely been found.

Pregnancy in the Tube.—Of the 68 cases of hernia of the tube, there was tubal pregnancy in 11; in 6 of these the tube was alone in the hernial sac, and in 5 the ovary was also present.

A hydrocele may be found in the sac with the ovary or tube occluding the neck. Neboux saw this condition in an inguinal hernia. Camper reported a case of hydrocele in a femoral hernia with the ovary adherent in the neck of the sac; Bérard saw a case in which the tube occluded the femoral opening, and the hydrocele contained nearly a gallon of fluid. Dardanelli found the fallopian tube and part of the bladder in a femoral hernia.

2. *Hernia of the Uterus*.—Hernia of the uterus hardly ever occurs alone, and is most frequently associated with hernia of the ovary and tube, usually of the side on which the hernia appears. The uterus and both ovaries and tubes have been found infrequently in the same sac; they were present in 14 of the cases I collected. Bilateral hernia of a bicornate uterus is very rare; I found 4 cases of the inguinal variety. Intestine and omentum are usually present in hernia of the non-pregnant uterus.

5. Pathology of the Hernial Contents.—

1. *The Ovary and Tube*.—The changes in the sac are similar to those found in other types of hernia. On account of the frequency of suppurative diseases of the tube, abscess is sometimes found in the sac. In hernias of short duration, the ovary is usually normal. On account of its exposed position it is subject to trauma and disturbances in circulation; it may become inflamed, tender and painful. Atrophy may occur, but it usually is not severe enough to check ovulation or menstruation. Several instances are on record where a pregnancy has occurred in a preexisting hernia of the ovary, tubes and uterus. The most frequently observed pathological change in the ovary is cystic degeneration. Fargas described a herniated ovarian cyst that reached to the patient's knees; Grant saw an ovarian cyst measuring 5 inches (12.5 cm.) long, in a femoral hernia. Lallement observed a hydatid cyst,

and Verdier saw a dermoid cyst. Malignant degeneration of the herniated ovary was reported in 4 of the cases I collected. Guersant saw cancer of both ovaries in a hernia in a 3-year old child. Tuberculosis of a herniated ovary is rare; I have found only a few cases reported in the literature.

The entire tube may be in the herniated sac or only the fimbriated end. If the tube alone is in the sac, it will form a loop, which may rarely be the seat of strangulation. The tube may be free in the sac or it may be bound down by adhesions. It is more frequently normal than the ovary. The lumen may be obliterated; there may be a hydrosalpinx, a pyosalpinx, or rarely malignant changes.

2. *The Round Ligament.*—The round ligament may accompany the ovary and tube into the sac, and in rare instances it is the cause of strangulation. Chevrier and Dardanelli have written important papers on hernia of the round ligament.

3. *The Uterus.*—The uterus is rarely normal. It is usually elongated; it may be anteflexed or retroverted; sometimes it is twisted upon itself or there may be a lateral version, or there may be a uterine fibroma. Malformation, such as rudimentary uterus is common; the uterus may be unicornate or bicornate. In 14 cases of hernia of the nonpregnant uterus, that I collected, the uterus was rudimentary. The vagina is frequently imperforate. In a few of the reported cases the patients were pseudohermaphrodites; true hermaphroditism is rare.

Etiology

1. *The Ovary and Tube.*—The cause of hernia of the ovary and tube is not known. The principal factor is probably congenital predisposition, as a majority of these hernias are observed at birth or soon after. Of 174 cases reported by Macready, 134 of the patients were under 5 years of age. Of the 367 cases I collected, 161 were under 10 years old. A majority of the inguinal hernias in little girls contain the ovary and tube. Congenital development of these hernias is favored by the proximity of the ovary to the hernial opening, and by the mobility of the ovary and tube which may have an abnormally long broad ligament. The canal of Nuck may remain open for some time after birth, or even throughout life, although it is normally obliterated about the eighth month of fetal life. During intrauterine life, the internal genital organs are above the pelvic cavity. At the 16th week of fetal life the ovary lies in the lumbar region, and it descends to the iliac fossa about the 20th week. According to Puech, this is the most favorable time for the ovary to enter the inguinal canal. The ovary is usually not in the pelvis at the end of the first year of life. The left ovary slightly precedes the right in their descent, and the condition is analogous in a way, to the descent of the testicles; although the round ligament becomes longer instead of shorter, as is the case with the gubernaculum testis. As a matter of fact, there is no similarity between the descent of the testicle and the eventration

of the ovary in inguinal hernia, because the testicle is retroperitoneal, and the ovary is intraabdominal and has a free mesentery. Conditions that favor the development of a hernia of the ovary and tube prevail until about the tenth year, when the ovary finally descends to its permanent position in the pelvis.

An acquired hernia is favored by a patent canal of Nuck and by the relaxation of the parietal peritoneum which predispose to sliding hernia, in which the hernial contents are drawn into the posterior part of the sac by means of their natural peritoneal attachments. Schönmeier believed that hernia of the ovary was usually due to traction exerted by the fallopian tube. The free mobility of the ovary and tube following pregnancy may also be a causative factor.

Exciting causes may be a fall, a strain, such as whooping cough or bronchitis, and laborious occupations. The cause of hernia of the tube alone is not known. It is probable that it is produced by the same conditions that cause hernia of the ovary and tube, and something occurs to prevent the ovary from entering the hernia. The hernial opening is perhaps too small or the ovary may be too large, or it may be held down by its greater weight and lower position. Kousmine measured the tubes in cadavers of newly born infants and found the middle of the tube was 14 mm. from the inguinal orifice, while the fimbriated extremity was 13 mm. from the femoral opening. This led him to agree with Cruveilhier that the tube precedes the ovary in descent.

2. The Uterus.—Hernia of the uterus is found most frequently in women who have borne several children. It may be congenital or acquired; the congenital variety is very rare. The hernia usually occurs in a patient who has a large inguinal or umbilical hernia. Pressure of nearby tumors or displacements of the uterus or adnexa may also be causative factors. A pre-existing hernia of the ovary and tube may become adherent in the sac and as the hernia enlarges, the uterus is drawn into the sac. Hernia of the pregnant uterus (*hysterocele gravidarum*) is infrequent. The uterus may become impregnated while in the hernia, as occurred in one of the cases I collected, or it may enter the hernial sac during pregnancy, and as it enlarges the hernia becomes irreducible. (Fig. 231.)

Symptoms and Diagnosis

1. The Ovary and Tube.—The symptoms of hernia of the ovary and tube are practically always confined to the ovary alone and depend largely upon the age of the patient. In the infant and child the ovary appears as a hard oval tumor the size of a pea, or a little larger, and is freely movable. It may lie in the inguinal canal or outside the external ring in the labium majus; it may be reducible or irreducible. Intestine is present in only about 15 per cent of irreducible hernias of the ovary and tube. The diagnosis of an inguinal hernia in a female child is usually easy, as it almost always con-

tains only the ovary and tube, omentum being a very rare content. It causes little discomfort, and is seldom painful, although in the case described by Boulfroy, pressure on the hernia caused epileptic convulsions.

In the adult the subjective symptoms are more pronounced. While the normal ovary is insensitive, the herniated ovary is sometimes hypersensitive, probably on account of the constant irritation due to its exposed position. It may be painful on palpation and even becomes turgescient, with referred



Fig. 231.—Irreducible inguinal hernia of the pregnant uterus.

sensations or pain in other genitalia. Swelling and pain in the ovary are usually most pronounced at the menstrual period. Occasionally the external ovary is small, atrophied, and insensitive to manipulation and pressure. In certain instances the pain may be so severe that excision of the ovary is required to relieve it. In cases reported by Lassus, Guersant, and others, the pain was so marked that the patients had difficulty in walking.

The diagnosis is more difficult in adults because the hernia is larger and often contains intestine and omentum, and the presence of the internal geni-

talia is less constant than in children. The most valuable means of diagnosis, as pointed out by Lassus, is vaginal or rectal examination. The uterus is found displaced to the same side as the hernia. A uterine sound is often helpful to determine the position of the uterus. The ovary can be moved by displacing the uterus posteriorly, or to the opposite side. In the event of a bilateral hernia, both ovaries should be displaced by tilting the uterus first to one side, and then to the other. Rabinovitz saw a case of bilateral inguinal hernia of the ovaries and tubes. The tumors were reducible, but reappeared as soon as pressure was released, irrespective of the posture assumed by the patient.

Hernia of the tube alone seldom causes symptoms, except those following traction on the ovary or uterus. The tube may rarely become sensitive during menstruation. The diagnostic signs are the same as those of hernia of the ovary; the condition is practically never diagnosed prior to operation. Five cases of tubal pregnancy in a hernial sac have been recorded in the literature. Birman called attention to the danger of rupturing the tube from attempts at taxis and producing a general peritonitis.

2. The Uterus.—Hernias of the uterus are very rare in children. I found 12 cases in infants under a year old, but none between the ages of 1 and 10 years. Most of the cases on record are found in true or false hermaphrodites.

Hernias of the non-gravid uterus are most frequent after the menopause. They may be reducible or irreducible. Strangulation is rare and complications are infrequent. The symptoms in these cases may be due to the presence in the sac of the ovary and tube along with the uterus. Diagnosis is aided by vaginal examination, and sometimes the passage of a uterine sound is helpful.

In Farrar's case of hernia of the uterus and both adnexae, the tumor appeared in the inguinal canal about the second or third month of gestation, in the second, third, and fifth pregnancies. It did not appear during the first or fourth pregnancies. After the fifth pregnancy it appeared on the seventh day postpartum, and remained reducible for four weeks, when it suddenly became irreducible and painful. In Macon's case of ventral hernia of the pregnant uterus, the latter entered the hernial sac and remained there until the onset of labor when it was forcibly reduced into the abdominal cavity. This happened in three successive pregnancies.

Royster's patient was 45 years old and had never been pregnant. The menstruation had always been vicarious, the flow proceeding from her nose every 28 days, accompanied by headache and pain in the epigastrium. A left inguinal hernia was noticed at the age of 14, which had grown rapidly during the 12 months previous to examination, and the tumor was the size of a fist, hard, tender and irreducible. At operation the uterus was found to contain a large fibroid, the left ovary and tube were in the sac, and there was a congenital absence of the right tube and ovary.

Hernia of the uterus complicated by pregnancy presents few symptoms before the fourth month, when the signs of uterine pregnancy are demonstrable, namely, the fetal heart beat, the outline of the parts, and fetal movement. In the inguinal variety, there is usually a history of a large reducible tumor, which does not become irreducible until the pregnancy is well along; while in the umbilical type, the pregnant uterus usually does not enter the hernia until the latter half of pregnancy, and may not become irreducible until the onset of labor. This form of pregnancy not infrequently terminates in abortion. In Scanzoni's case, the patient had two intrahernial pregnancies that terminated in abortions at the second and fifth months.

3. Complications and Sequelae.—Hernias of the ovary, tube and uterus are liable to certain complications, the most frequent being torsion and strangulation of the adnexa, and infection of the sac.

a. *Torsion of the Adnexa.*—Torsion of the adnexa is a frequent complication of hernia of the ovary and tube in children under two years of age. The symptoms are indefinite—crying, restlessness and irritability; vomiting and tympanites are rare. There is an irreducible tumor in the hernial region, which is swollen, tender and painful. If the torsion is long-continued or severe, strangulation is liable to occur. Müller reported the case of an infant, 5 months old, whose left ovary and tube had been removed on account of strangulation; five weeks after this was done a hernia of the tube and ovary appeared on the right side. On account of the strangulation, an operation was performed and the tube and ovary returned to the abdominal cavity and the hernial opening closed. Eustace and McNealy saw a case of strangulated inguinal hernia of the ovary and tube in an infant 6 months old. The right labium majus was red, swollen, tender, and pitted on pressure; there was no fluctuation or pulsation in the mass. At operation a torsion of 180 degrees of the tube and ovary was found. The adnexa were resected, and the child made an uneventful recovery. Belbin observed a torsion of 180 degrees of the tube, and Schnitzler saw one of 360 degrees. (Many others are reported in the literature.)

b. *Strangulation.*—Strangulation is almost always due to torsion of the pedicle and not to constriction by the hernial ring, and it is usually manifested by a tender, painful, irreducible mass, unless intestine is present, when there will be symptoms of nausea, vomiting and constipation. The mass tends to increase in size and may resemble a strangulated omentocoele. In some instances there is no pain, and strangulation is not discovered until during the course of an operation for a supposedly simple irreducible hernia. Peritonitis is rare. Müller saw a case in which a loop of intestine was strangulated in the hernial sac by the round ligament and ovary. Torsion of the tube is common.

In rare instances the tube is strangulated at the internal inguinal ring. Retrograde strangulation of the fallopian tube is very rare. Maydl recorded a case, and another has been reported by Vas. The latter case occurred in a

16-year-old girl with a right inguinal hernia. The loop in the sac was $4\frac{1}{2}$ inches (11 cm.) long, and the free end in the abdominal cavity was gangrenous. Prompt recovery followed excision.

c. *Abscess in the Hernial Sac*.—Suppuration sometimes occurs as a result of infection from the fallopian tube, which may also involve the ovary.

Differential Diagnosis

Hernia of the ovary, tube and uterus may be mistaken for a variety of conditions because of the frequency of congenital malformation in the internal genitalia, as well as other developmental anomalies. The presence of hermaphroditism or pseudohermaphroditism is not rare, and for this reason, a testicle may be mistaken for the ovary and tube.

Enterocoele.—Intestinal hernia is resonant, and is usually reducible with a gurgling sound. If it is irreducible, the symptoms are those of intestinal obstruction or strangulation. Omentum adherent in the hernial sac may confuse the diagnosis. If the hernia contains intestine, omentum, ovary and tube, a diagnosis is almost impossible unless the intestine and omentum can be returned to the abdominal cavity, and movement of the ovary obtained by vaginal examination.

Cysts of the Canal of Nuck.—Cysts in the canal of Nuck are fluctuating, translucent, and irreducible. Vaginal examination shows the uterus and adnexae in their normal position.

Abscess.—Strangulated hernia of the ovary and tube simulating abscess in the labium majus is difficult to diagnose in infants.

Other conditions that may simulate hernia of the ovary and tube are: Dermoid cyst in the canal of Nuck; enlarged lymph glands; lipoma, which is soft, insensitive and irreducible; cyst of the labium majus; and a tag of omentum, which is usually found attached to the upper part of the inguinal canal.

The non-gravid uterus in a hernial sac is usually difficult to diagnose, and is hardly ever looked for unless it causes symptoms. Its presence can sometimes be detected by vaginal examination, or by passing a uterine sound which enters the hernial sac. Hernia of the pregnant uterus may be mistaken for extrauterine pregnancy. When examination discloses the non-gravid uterus in the abdominal cavity, displaced towards and connected with the gradually enlarging tumor in the hernial sac, the condition is probably extrauterine pregnancy.

Prognosis

Hernia of the ovary and tube is not dangerous to life. While some cures result from truss treatment in infancy, they are very rare after the second year. The truss aggravates and hastens the degenerative changes which always occur in ovaries in this exposed position. The best outlook for the conservation of the ovaries is by immediate operation as soon as diagnosis

is made. After puberty there is always the danger of extrauterine pregnancy.

The prognosis of hernia of the non-gravid uterus is serious because of the danger of complications. The uterus in a hernial sac is more likely to undergo malignant change than a normal uterus, and should pregnancy occur in an inguinal hernia of the uterus, a normal delivery is almost always impossible and hysterotomy must be resorted to. Pregnancy in an umbilical hernia is less grave, because the neck of the sac is larger and the hernia can usually be reduced, even after the onset of labor.

The operation for hernia of the ovary and tube has had a low mortality even in preantiseptic days, because of the fact that the operation is usually extraperitoneal.

Treatment

1. Hernia of the Ovary and Tube.—Hernia of the ovary and tube in children can sometimes be retained in the abdomen by a bandage or truss, and in a few instances this treatment has resulted in a cure. On account of the effects of pressure on the ovary and tube, the disturbances in circulation, the dangers of atrophy and the chance of cystic and malignant disease, operative treatment should always be advised.

Whenever possible, the ovary should be returned to the abdominal cavity because of the importance of its function as an endocrine gland. In true torsion of the ovary and tube, if gentle taxis is not successful, immediate operation is indicated on account of the danger of gangrene, which not infrequently follows expectant treatment. When a portion of the ovary is cystic, it can be partially resected. In the presence of suppuration, extensive cystic degeneration or neoplastic changes, the ovary and tube must be removed.

2. Hernia of the Uterus.—Hernia of the non-gravid uterus should always be treated by reduction of the tumor and operative closure of the hernial opening, because of the serious complications that might ensue should pregnancy occur.

Hernia of the pregnant uterus should be reduced and retained by a firm bandage; or better still, a radical operation undertaken and the hernial opening closed. If the patient is seen for the first time, near term, and the hernia is irreducible, a hysterotomy should be done, followed by hernioplasty at a later operation, as it is seldom possible to reduce the large uterus through the hernial ring until after involution has taken place.

Bibliography

HERNIA OF THE UTERUS, OVARY, FALLOPIAN TUBE AND UTERUS

- ADAMS, S. S.: Hernia of the pregnant uterus. *Am. J. Obst.*, N. Y., 1889, xxii, 226-246.
 ANDREWS, F. T.: Hernia of the tube without the ovary. *J. Am. M. Assn.*, Chi., 1905, xlv, 1625-1628.
 ANDREWS, F. T.: Hernia of the uterus. *Tr. Am. Gynec. Soc.*, Phila., 1906, xxxi, 407-426.

- BARNES, R.: On hernia of the ovary and observations on the physiological relations of the ovary, with the relation of cases observed by the author. *Am. J. Obst., N. Y.*, 1883, xvi, 1-25.
- BELBIN, H. A.: A case of hernia of the ovary in a child 7 months old. *Brit. M. J. Lond.*, 1898, i, 1389.
- BÉRARD, A.: Observation de hernie de la trompe de Fallope; hydropsie du sac herniaire; ponction; péritonite; mort. *Expérience, Par.*, 1839, iii, 216-220.
- BIRMANN, A.: Ein Beitrag zur Kasuistik der Adnexhernien. *Wien. klin. Wehnschr.*, 1922, xxxv, 583-584.
- BIRNBAUM, R.: Beitrag zur Kenntnis der Hernia uteri inguinalis und der histologischen Veränderungen verlagelter Ovarien. *Berl. klin. Wehnschr.*, 1905, xlii, 632-635.
- BECKEL, J.: Extirpation d'une matrice et d'une trompe herniées chez un homme. *Gaz. méd. de Strasb.*, 1892, li, 87-89.
- BOIVIN, M. A. V. G., AND DUGÉS, A.: *Traité pratique des maladies de l'uterus et de ses annexes fondé sur un grand nombre d'observations cliniques.* Paris, J. B. Baillière, 1834, i, 27.
- BORDEAU, M.: De la hernie complète des organes génitaux profonds de la femme en dehors de la grossesse. Thèse, Paris, 1905.
- BOULFROY, D.: Des hernies des organes génitaux de la femme. Thèse, [Lyon] Dijon, 1904.
- BOYER, A.: Hernie de l'ovaire. In: *Traité des maladies chirurgicales.* 3rd ed. Paris, Migneret, 1822, viii, 387-390.
- BRUNNER, C.: Herniologische Beobachtungen. *Beitr. z. klin. Chir., Tübing.*, 1888-1889, iv, 1-39; 259-320.
- CAMPER, P.: *Demonstrationum anatomico-pathologicarum.* Amstelaedami, J. Schreuder et P. Mortier, 1762, ii, 17.
- CHÉNIEUX, F.: Tumeur volumineuse de la région fessière droite. Hernie de l'ovaire. Ablation. Guérison. *Bull. et mém. Soc. de chir. de Par.*, 1890, xvi, 396.
- CHEVRIER, L.: Le ligament rond dans les hernies crurales. *Rev. de chir., Par.*, 1907, xxxv, 245-259.
- CHIENE, J.: Case of obturator hernia. *Edinb. M. J.*, 1870-1871, xvi, 601-603.
- CORMACK, J. R.: On hernia of the uterus. *Lond. & Edinb. Month. J. M. Sc.*, 1841, i, 491-501.
- COSTA, U. G.: Contributo clinico allo studio dell'ernia annessiale. *Riforma med., Napoli*, 1912, xxviii, 1128-1135.
- CRANWELL, D. J.: Les hernies inguinales de l'utérus. *Rev. de chir., Par.*, 1908, xii, 777-814.
- CRUVEILHIER, J.: *Traité d'anatomie pathologique.* Paris, Baillière, 1849, i, 645.
- DARDANELLI, M.: Ernia crurale destra strozzata contenente la tromba e la vescica (etc.). *Riforma med., Napoli*, 1910, xxvi, 208-212.
- DARDANELLI, M.: Il legamento rotondo nelle ernie crurali. *Riforma med., Napoli*, 1912, xxviii, 287-297.
- DENEUX, L. C.: Recherches sur la hernie de l'ovaire. Paris, Gabon, 1813.
- DOLBEAU, H. F.: Une hernie de la trompe. *Bull. Soc. anat. de Par.*, Baillière, 1854, xxix, 72.
- EISENHART, H.: Fall von Hernia inguinalis cornu dextri uteri gravidi. *Arch. f. Gynaek., Berl.*, 1885, xxvi, 439-459.
- ENGLISH, J.: Ueber Ovarialhernien. *Wien. med. Presse*, 1868, ix, 349-350; 373-375; 420-422; 451-453.
- EUSTACE, A. B., AND MCNEALY, R. W.: Case of strangulated tubo-ovarian hernia in an infant. *J. Am. M. Assn., Chi.*, 1914, lxii, 772-773.
- FARGAS: Note sur un cas de hernie inguino-labiale de l'ovaire droit avec gros kyste réticulaire du même organe. *Arch. de tocol., Par.*, 1890, xvii, 767-768.
- FARRAR, L. K. P.: Hernia of the uterus and both adnexae. *Surg. Gynec. & Obst., Chi.*, 1913, xvii, 586-597.
- GARRIGUES: See Jaboulay, M. et Patel, M.: p. 392.
- DE GOUÉY, L. L.: La véritable chirurgie, établie sur l'expérience et la raison. Rouen, P. P. Cabut, 1716, v, 401.
- GRANT, W. W.: Femoral hernia of the ovary. *J. Am. M. Assn. Chi.*, 1920, lxxv, 289-290.
- GUERSANT: Hernie de l'ovaire par le canal inguinale. *Bull. Soc. de chir. de Par.*, 1851-2, ii, 127-131.
- HAMILTON, F. H.: Congenital inguinal hernia; ovarian, etc. *Bellevue & Char. Hosp. Rep., N. Y.*, 1870, p. 159-161.
- HEWITT, H. W.: Hernia of the female internal genitalia through the inguinal canal. *Am. J. Obst. & Gynec., St. Louis*, 1923, v, 530-535.
- HILGENREINER, H.: Beitrag zur Kenntnis der Hernia uteri inguinalis. *Berl. klin. Wehnschr.*, 1906, xliii, 319-323.

- JOPSON, J. H.: Hernia of the uterus through the inguinal canal. *Ann. Surg., Phila.*, 1904, xl, 98-106.
- KOUSMINE, B. J.: Tumeur volumineuse de la région iléo-fémorale gauche constituée par une hernie de la trompe utérine. *Rev. de chir. Par.*, 1895, xv, 313-323.
- KÜSTNER: See Veit: *Handbuch der Gynäkologie*. Wiesbaden, J. F. Bergmann, 1897, i, 226.
- LALLEMENT: Sur la hernie inguinale de la matrice. *Mém. Soc. méd. d'émulat. de Par.*, (an vii), an viii (1800), iii, 323-325.
- LASSUS, P.: *Pathologie chirurgicale*. Paris Méquignon, 1805, ii, 98-102.
- LAVATER, J. H.: De intestinorum compressione. Basileæ, 1672. *In*: Haller. *Disputationes chirurgicæ selectæ*. Lausannæ, Bousquet, 1755, iii, 37-62.
- LEGUEU, F.: Hernie congénitale de l'utérus et des annexes; imperforation du vagin. *Bull. Soc. anat. de Par.*, 1897, lxxii, 302-305.
- LEJARS, F.: Néoplasmes herniaires et péri-herniaires. *Gaz. d. hôp., Par.*, 1889, lxii, 801-811.
- LEJARS, F.: Hernie inguinale simultanée de la trompe utérine et de la vessie; les hernies de la trompe; les lésions opératoires de la vessie herniée. *Rev. de chir., Par.*, 1893, xiii, 12-31; 111-138.
- LOCKWOOD, C. B.: A case of hernia of the ovary in an infant with torsion of the pedicle. *Brit. M. J., Lond.*, 1896, i, 1442.
- LOUMAIGNE, I.: De la hernie de l'ovaire. Paris, F. Savy, 1869.
- MACON, A. L.: A case of ventral hernia in which the pregnant uterus formed the contents of the hernial sac. *South. Pract., Nashville*, 1899, xxi, 250.
- MACREADY, J. F. C. H.: A treatise on ruptures. London, C. Griffin & Co., 1893.
- MANEGA, U.: Dell'ernia inguinale dell'ovario. *Riforma med., Napoli*, 1894, x, pt. i, 495-498; 507-511.
- MAYDL, K.: Die Lehre von den Unterleibsbrüchen. (Hernien). Wien, J. Safar, 1898.
- MENCIÈRE, L.: Hernie de l'ovaire particulièrement chez la petite fille. *Rev. mens. d. mal. de l'enf., Par.*, 1897, xv, 270-280.
- MORF, P. F.: Hernia of the Fallopian tube without hernia of the ovary. *Ann. Surg., Phila.*, 1901, xxx, 247-268.
- MÜLLER, G. P.: Inguinal hernia complicated by hernia of the ovary and tube. *Ann. Surg., Phila.*, 1918, lxxvii, 380.
- NEBOUX: Observation d'une hernie de l'ovaire droit étranglée; opération; guérison. *Bull. gén. de thérap., etc., Par.*, 1845, xxviii, 286-289.
- OGÉ, A.: Des hernies de l'utérus et des annexes. Thèse, Paris, 1900.
- POL, N.: See Fabricius Hildanus, G.: *Opera quæ extant omnia*. *Epistola herniæ uterinæ*. M. Doringius. Francofurti, J. Beyert, 1646, p. 896.
- PUECH, A.: Nouvelles recherches sur les hernies de l'ovaire. *Ann. de gynéc., Par.*, 1879, xi, 401-430.
- RABINOVITZ, M.: Double ovarian inguinal hernia, absence of the uterus, and a rudimentary vagina. *Med. Rec., N. Y.*, 1915, lxxxvii, 586.
- ROYSTER, H. A.: Inguinal hernia of the uterus. *South. M. J., Birmingham*, 1920, xiii, 275-279.
- SCANZONI, F. W.: Ein Fall von Hysterokele inguinalis mit hinzutretender Schwangerschaft. *Beitr. z. Geburtsh. u. Gynaek., Würzburg*, 1870-1873, iii, 167-183.
- SCHNITZLER, J.: Torquite Ovarialhernie. *Wien. klin. Rundschau*, 1903, xvii, 793.
- SCHÖNMEIER, A.: Ueber Ovarialhernien. *Beitr. klin. Chir., Tübing.*, 1923, cxxviii, 451-460.
- SCHWARTZ, E.: Hernies inguinales des deux canaux de Müller. Cure radicale. Absence totale de vagin. Vagin artificielle. *Cong. franç. de chir., Proc. verb. (etc.)*, Par., 1892, vi, 437-439.
- SENNERTUS, D.: *Magno opere medicinæ practicæ*. Witteberg, 1628. *In*: Haller's *Bibliotheca Chirurgica*. Bernæ & Basileæ, Haller et Schweighauser, 1774, i, 290.
- SORANUS: See Oribasii Sardiani. *Venetis, V. Valgrisi*, 1568, p. 37.
- THOMAS, L. E. A.: De la hernie inguinale de l'ovaire. Thèse, Paris, 1887.
- VAS, B.: Retrograde inkarzeration der Tuba. *Zentralbl. f. Chir., Leipz.*, 1920, xlvii, 374.
- VERDIER, C.: Sur la hernie de la vessie. *Mém. Acad. roy. de chir., Par.*, 1753, ii, 1-58.
- WIART, P.: Double hernie congénitale des trompes, sans hernie de l'ovaire. *Bull. Soc. anat. de Par.*, 1898, lxxiii, 537-540. Also, 1899, lxxix, 59-60.
- WIBAILLE, G.: Des hernies de l'ovaire. Thèse, Paris, 1874.

CHAPTER XXIX

MEDICO-LEGAL ASPECTS OF HERNIA

The medico-legal aspects of hernia are conveniently considered under two headings: (1) Traumatic and industrial hernia; (2) The legal responsibility in the treatment of hernia.

Traumatic and Industrial Hernia

As a result of the establishment of state industrial commissions and compensation boards, the subject of traumatic and industrial hernias has become of great importance to all industrial organizations. Much confusion regarding the etiology of hernia is due to the use of the old word "rupture" (see chapter on general observations), and to the use of the term "traumatic hernia," to describe occupational or industrial hernia.

The simplest classification of these hernias divides them into 3 groups, as suggested by the French writers, namely, (1) true traumatic hernia, which is due to direct violence; (2) hernia of weakness, which is the result of a deficiency or malformation in the development of the structures in the hernial regions; and (3) occupational hernia (hernia of effort), which is due to a sudden increase in intraabdominal tension.

1. **True Traumatic Hernia.**—True traumatic hernia is very rare and only a few cases have been reported in the literature. This hernia is due to an injury that tears the tissues, either by a crushing blow, a fall from a height or a laceration of the structures by a sharp instrument.

Selby reported an unusual case of direct abdominal hernia in a man who fell from a scaffold and was struck by a wheelbarrow handle in the right iliac region. He complained of very severe pain and the skin was slightly abraded, but not discolored. Operation disclosed breaks through the aponeurosis of the external oblique, the internal oblique, and transversalis muscles. The rupture of the aponeurosis was in the direction of its fibers, and as clean-cut as if it had been made with a knife.

2. **Hernia of Weakness.**—Hernias of weakness are due to deficiency or malformation of the muscles or fascia of the abdominal wall in the hernial region. This deficiency is the result of faulty development or disease.

In the inguinal region, these hernias are nearly always of the direct variety. Strictly speaking, they do not have a congenital sac and for this reason they are very rare.

3. **Occupational, Industrial or Accidental Hernia (Hernia of Effort).**—Occupational hernia constitutes over 99 per cent of all the hernias that come

before state industrial commissions, to be considered from a medico-legal aspect. Occupational hernia is due to a sudden or gradual increase in intraabdominal tension, which may be caused by a fall from a height, a misstep or a slipping, hard manual labor, a sudden strain, coughing, sneezing, whooping cough, etc. As a result of such effort, there is a descent of abdominal viscera, usually omentum, intestine, or both, into a preformed sac.

It is generally agreed that by far the most important cause of all varieties of hernia is the presence of a congenital sac or peritoneal diverticulum at

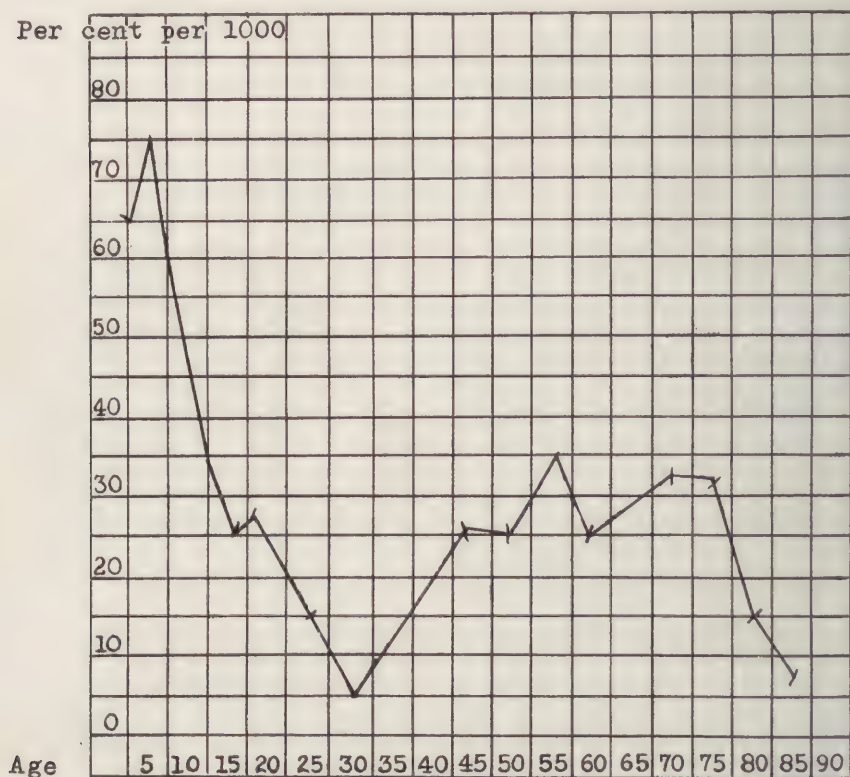


Fig. 232.—Berger's chart showing the frequency of hernia at different ages, based on an examination of 10,000 subjects.

the hernial orifice, or in the canal. (The active and predisposing causes of congenital hernia have been considered in detail in the special chapters, particularly in those on inguinal and femoral hernias.) Nearly all industrial hernias are inguinal, consequently they overshadow in importance all other varieties put together. The usual predisposing causes of inguinal hernia, an anatomic weakness and a congenital preformed sac, combined with a common exciting cause, such as a sudden or prolonged strain, are etiologic factors that lend themselves admirably to legal controversy. (Fig. 232.)

While the congenital theory of the origin of inguinal hernia is generally

recognized, the courts as well as the industrial boards have not always accepted it. This attitude is based on the long line of English court decisions, that "excessive strain must be regarded as an injury." The courts do not always accept the views of surgeons and anatomists, and the law is based largely on precedent decisions in similar cases. Wainwright has recently summarized the literature on the congenital sac theory with especial regard to its relation to workmen's compensation laws.

Colcord believed that the abdominal wall is weakened and occupational hernia predisposed to by hard labor, excessive drinking, poor food, faulty hygienic homes and mills, heredity, tuberculosis and syphilis. Plummer stated that the importance of pressure from lipomata in the inguinal canal is of more importance than is generally supposed.

Differential Diagnosis

A number of conditions may be mistaken for hernia. (The differential diagnosis is fully dealt with in the special chapters.)

Germany (1884) was the first country to pass a workmen's compensation act. Austria, Switzerland, Denmark, Norway, England, and other countries soon followed with similar laws; and at the present time in the United States such laws are in force in a majority of the states.

The German courts have held that traumatic hernia is subject to the following conditions:

1. The relationship between the accident and the hernia must be proved by an examination made within forty-eight hours.
2. It must be proved that the hernia appeared suddenly.
3. It must appear immediately after the accident and be accompanied by pain.
4. Proof must be furnished that the hernia did not exist prior to the accident.

The indemnity awarded by German courts has usually been reduced on proof that a congenital or acquired predisposition existed before the accident.

The Swiss courts define the following rules for compensable hernia:

1. The hernia must appear suddenly.
2. It must be of recent origin.
3. It must be accompanied by pain.
4. It must immediately follow an accident.
5. It must be proved that the hernia did not exist prior to the accident.

The Swiss law awards damages in proportion to the predisposition proved.

The French courts have ruled that there exists "evidence of the relationship between the work performed by the laborer and the manifestation of the hernia."

The French courts have ruled that traumatic and accidental hernias are compensable, but the hernias of weakness are not.

The California and Nevada State Industrial Commissions were among the first to rule that industrial hernias are almost always due to the presence of a preformed sac.

The California Industrial Commission rules:

"The consensus of medical and surgical opinion runs to the effect that hernia is very rarely, in any proper sense, the result of an accidental injury; that the accident at best is no more than the occasion, instead of the cause of the malady; that the origin of the difficulty is congenital and more in the nature of a disease than an injury; that every claim for compensation based upon an alleged rupture is to be viewed with suspicion."

The Nevada Industrial Commission rules:

"Medical science teaches now what it has taught for the past twenty years and is now accepted as a medical and scientific truth, corroborated as such by the foremost surgeons and anatomists in the world; that is, that hernia, or so-called rupture, is a disease, ordinarily developing gradually, and is very rarely the result of accident."

The Nevada Industrial Commission has promulgated the following rules:

"Rule I. Real traumatic hernia is an injury to the abdominal wall (belly wall) of sufficient severity to puncture or tear asunder said wall and permit the exposure or protrusion of the abdominal viscera or some part thereof. Such injury will be compensated as temporary total disability, and as partial permanent disability, depending upon the injured individual's earning capacity.

"Rule II. All other hernias, whenever occurring or discovered and whatsoever the cause, except as under Rule I, are considered to be diseases, causing incapacitating conditions or permanent partial disability; but the permanent partial disability and the cause of such are considered, as shown by medical facts, to have either existed from birth, to have been years in formation, or both, and are not compensatory, except as provided under Rule III.

"Rule III. All cases coming under Rule II in which it can be conclusively proved, first, that the immediate cause which calls attention to the presence of the hernia, was a sudden effort or severe strain or blow, received while in the course of employment; second, that the descent of the hernia occurred immediately following the cause; third, that the cause was accompanied or immediately followed by severe pain in the hernial region; fourth, that the above mentioned facts were of such severity that they were noticed by the claimant and communicated immediately to one or more persons, and are considered to be aggravations of previous ailments or diseases, and will be compensated as such for time or loss only, depending on the nature of the proof submitted and the result of the local medical examination."

Coley, Leigh, Walker, Hopkins and Hutchison pointed out that "Rule II states specifically that by medical facts it is shown that a hernia either exists from birth or is years in formation; whereas, in the second proof of Rule

III, it speaks of a descent of hernia occurring immediately following a strain or blow. This assumes that hernia may be the result of a single increase of abdominal pressure which the Commission in Rule II stated to be impossible."

While an accident or strain often first calls the patient's attention to the condition, it must be remembered that a single strain or injury causing increased intraabdominal pressure, cannot produce a hernia unless there is a preformed peritoneal sac to receive the omentum or intestine. The descent of omentum or intestine into a small empty peritoneal pouch or potential sac is often accompanied by slight pain.

Recent industrial hernias are not accompanied by ecchymosis of the skin, and they are not painful or tender to the touch. A careful examination of the sac, rings, and canal at operation will furnish conclusive proof of the duration of the hernia. A thick, tough sac firmly adherent to the cord or other surrounding structures, and large hernial rings are evidence that the hernial sac has been present for years, and part of it since birth. Some patients honestly believe the strain was the cause of their hernia; others know they had a hernia, and it is not uncommon for them to seize the occasion of the strain or injury as a means of getting some "easy money," with the aid of an eloquent attorney to sway a sympathetic jury.

A strain alone cannot produce a hernia. This is proved by the fact that severe trauma, such as a fall or crushing injury, may cause fatal internal injuries, rupture of the bladder, stomach, intestine, diaphragm, liver, kidney or spleen, without producing an inguinal hernia, providing the processus vaginalis has been completely obliterated. An examination of the external inguinal fossa during the course of an abdominal operation is sufficient to convince the surgeon of the strength of these structures, and of the fact that all the pressure that can be exerted with the examining finger is not sufficient to force a passage through the internal ring. In fact, it is much easier to produce a hernia by entering the external ring and then dilating the inguinal canal and internal ring. (See chapter on artificial hernia.)

It is evident that a single strain, no matter how violent, is incapable of producing a hernia, without tearing the muscles and fasciae, causing subcutaneous or peritoneal hemorrhage, and swelling and ecchymosis of the skin over the hernia. In true traumatic hernia there is no sac, the hernia usually being of the ventral variety. It is very rare for the hernia to come through at one of the hernial openings.

Recommendations in Industrial Hernia

The recommendations of the Special Committee of the Medical Section of the American Railway Association are as follows:

- "1. Render proper compensation for all cases of true traumatic hernia,

due to direct violence. Such cases are so few in number as to be practically negligible.

"2. Make a physical examination of all applicants in industry no matter in what capacity; such examinations will determine the fact whether or not a hernia was present at the time of examination.

"3. Any hernia developing in the course of duty, incident to the man's daily work, should be treated as a disease due to special anatomical weakness on the part of the individual, for which the company is in no way responsible. If it is considered wise under certain circumstances to recognize any moral responsibility, let it be on an economic or humane basis. This moral obligation should be understood to be strictly limited to such employees who had been found apparently free from hernia at the time of previous physical examination."

The New York Compensation Commission is "rather inclined to take the view that hernia is not generally the result of trauma, yet, there was an unwritten rule established that, if the employer offered a correcting operation, and it was refused, an award would be made for eight weeks' disability and the case closed." However, in one case two or three years ago an award, made for a hernia claimed to be the result of a strain, was denied by the New York Court of Appeals on the ground that there was no cause or relation between the strain and the rupture. This ruling resulted in the strengthening of the prevailing opinion that trauma was a doubtful cause of the hernia. In a later case, March 15, 1921, the New York Court of Appeals affirmed an award in the case of a man, who claimed his hernia was the result of a strain caused by lifting a 700-pound box of clay. The court stated that there was no doubt that it was an accidental injury within the meaning of the statute.

Colcord stated that the Pennsylvania, Illinois, Michigan and Wisconsin Compensation Boards rule in accord with English law, that "where a strain causes protrusion of the bowels it is a compensable injury, even though the protrusion is at a point weakened by congenital malformation or pre-existing hernia."

California, Washington, and West Virginia deny compensation where a strain brings on a protrusion of bowel through an old hernia.

Failure of Proof of Hernia

The Supreme Court of Iowa affirmed a ruling of the industrial commissioner in denying compensation to a man who claimed his hernia was caused by climbing a high fence. The plaintiff did not consult a physician for two and a half weeks after the injury, and the court held he had not met the requirements of the burden of proof to justify an award of compensation. (*Bunele vs. Sioux City Stockyards Co.* [Iowa], 185 N. W. R. 139.)

Hernia Resulting from Accident

The plaintiff (Metropolitan Casualty Insurance Company vs. Edwards [Texas] 210 S. W. R., p. 856) while attempting to alight from an automobile, slipped and fell, striking the edge of the door of an automobile and sustaining an injury of the groin. Later, a hernia developed and he sued the insurance company, claiming the hernia was due to the accident. The upper court affirmed the judgment of the lower court in awarding the plaintiff damages, covering the period of his disability between the time of the accident and the operation for hernia.

(Poccardi vs. Public Service Commission [W. Va.] 84 S. E. R. 242.) The Supreme Court of Appeals of West Virginia holds that a rupture caused by a strain while at work is an accident or untoward event, arising in the course of employment, and compensable under the workmen's compensation act. Proof of apparent previous good health, a heavy and unusual lift in the course of work, discovery of the rupture on the second day thereafter, death from surgical operation for relief thereof, and opinion of the operating surgeon that the rupture was caused by the lifting, is sufficient to establish accidental injury in the course of employment, within the meaning of said act.

Duration of Compensation Period

The courts have usually held that compensation should not be continued beyond the time ordinarily required for recovery from a hernia operation, nor can a man continue to receive compensation, and at the same time refuse to submit to proper medical or surgical treatment such as an ordinarily reasonable man would submit to in like circumstances. (Schiller vs. B. & O. R. R. [Md.] 112 Atl. R. 272.)

The Supreme Court of Kansas affirmed a judgment of the lower court in the case of a man who sought compensation under the workmen's compensation law of Kansas. The court ruled that as the man refused to submit to an operation, compensation to be paid to him should cease at the end of 25 weeks. (Strong vs. Sonken-Galamba Iron and Metal Co. [Kan.] 198 Pac. R. 182.)

The Supreme Court of Tennessee reduced a decree which allowed the claimant \$4.73 a week for 300 weeks on account of his having, while in the employ of the plaintiff, received an injury which produced a hernia, the reduction being to \$4.73 a week for 13 weeks. The court says that the evidence showed that a person so injured can never do efficient work; that the injury will likely become greater as time passes; that the earning capacity of the claimant had been reduced one-third; that the only cure for a hernia is a surgical operation; that it is not a serious operation attended with unusual danger or pain, and can be successfully performed under a local anesthetic; that such an operation usually restores a man to his former

earning capacity; that, when performed by skilled surgeons, virtually all such operations are successful; that the claimant in this case was physically able to undergo the operation, and that an operation was recommended by the several physicians who examined him. Under these facts, the court is of the opinion that the employer was within his right in demanding that the claimant submit to an operation.

The workmen's compensation act of Tennessee is broad, and provides that the employer shall furnish medical and surgical treatment for 30 days following the service of notice, and that he may furnish it thereafter, which the employee must receive.

Cannot Require Submission to Hernia Operation

The Supreme Court of Oklahoma ruled that the Oklahoma Industrial Commission could not compel a man to submit to a hernia operation, involving a risk of life, however slight, in order that the pecuniary obligation created by the law in his favor may be minimized. (*Henley vs. Oklahoma Union Ry. Co. et al.* [Okla.] 197 Pac. R. 488.)

The Court of Civil Appeals of Texas, in affirming a judgment for damages for a double inguinal hernia and spinal trouble that were caused by a collision of a street car with an automobile in which the defendant was riding, ruled that the defendant did not have to submit to an operation even though it would lessen the effects of the injury; and that as a matter of law, one who has been injured by the negligence of another is not bound to undergo a serious and critical operation which would necessarily be attended with some risk of failure and of death, but must be permitted to exercise the liberty of choice in the matter. (*Houston Electric Company vs. Schmidt* [Texas], 244 S.W.R. 1110.)

Failure to Release Employer

The plaintiff, who was an employee of the Southern Pacific Railroad, was found to have lax inguinal rings at a preliminary examination. He was told of this defect, and in consideration of his employment he signed an agreement releasing the company from responsibility should a hernia develop. The provisions of the California Workmen's Compensation Act rendered this agreement ineffectual, and under the law, the plaintiff was entitled to compensation. (*Hines vs. Industrial Accident Commission* [Cal.], 188 Pac. R. 277.)

Electric Shock as a Cause of Hernia

In the case of a man who was seen to have been hanging to an electric wire for two to three minutes and fell when the current was turned off, it was claimed that the electric shock operated on some weakness in the abdominal wall, and caused the hernia. The pain in the abdomen was first

noticed three weeks after the accident, and was soon followed by the appearance of the hernia. The court concluded that the jury was justified in finding that the plaintiff's hernia was the result of the accident. (Murphy vs. N. Y., N. H. and H. R. R., N. Y. Appellate Division, 157 N. Y. Supp. 962.)

Preliminary Examination of Employees

The importance of a physical examination of all employees before they are hired cannot be too strongly emphasized, and it is the most effective means to lessen the number of cases of alleged traumatic or accidental hernia. Hopkins stated that of all the men who passed a physical examination before entering the railroad service, the claim of traumatic hernia was less than one per cent, while 91 per cent of the cases of alleged traumatic hernia were in those who were employed without a preliminary physical examination (Greeks, Italians, and Poles). Coleord pointed out that foreign laborers become prematurely old at 40 to 45 years, and after this age hernia is much more liable to occur than in young, well-musculatured men.

Coleord also stated that applicants who have a congenital open external ring with firm muscles and aponeuroses protecting the inguinal region run very little risk of a future hernia, while those with patulous external and internal rings and lax surrounding tissues are liable to develop hernia, and should be rejected. In examining for patulous rings and concealed hernia (in addition to the symptoms and signs described in the chapter on inguinal hernia) the skin should be carefully inspected for evidence of previous truss wearing. The rings should be examined while the patient lifts a heavy object and at the same time coughs. A normal canal grips the finger when the patient coughs, and the internal ring cannot be felt; weakness in the triangle of Hesselbach should also be looked for.

Frequency of Open Rings and Hernia

Coleord sent out questionnaires to surgeons in industrial surgery. One hundred answers, covering about 500,000 examinations, were complete enough to be of value. The more important answers were summarized as follows: 20 per cent of the surgeons examined applicants for hernia before employment. Of those examined, 10 per cent had open inguinal rings and 2 per cent had hernias. Twenty per cent of the surgeons who replied, believed that every open ring was a potential hernia, and 90 per cent of them believed hernia was due to a congenital defect. Only 2 or 3 cases of traumatic hernia were reported.

Coleord examined 9,000 men and found 784 (8.7 per cent) open rings, and 153 (1.7 per cent) hernias. Of 24 patients who subsequently developed hernia, only 3 had open rings at the time of the preliminary examination; 3 of the 784 patients with open rings later developed hernias.

Danger of Routine Hernia Operations

Coleord called attention to the risk attending the routine custom of certain companies in operating on all hernias occurring in their employees. He stated that in one patient, operation was followed by dementia; in another rapid tuberculosis and death resulted, and in still another patient, operation was followed by appendicitis and death. Although the hernia was not the cause of the conditions, the appendicitis case got an award of death benefits, and the other two were pending before the compensation boards.

Medico-Legal Responsibility in the Treatment of Hernia

The legal responsibility of the physician in the treatment of hernia is the same as in general surgery, and the reader is referred to special papers for detailed information, especially to the articles by Carson and by Woodward.

The following brief summary of the legal rights and duties of physicians has been prepared by Mr. Robert J. Folonie, General Counsel of the Illinois State Medical Society:

Consent to Operation.—Before any serious operation the consent of the patient should be secured expressly (in writing, if possible).

No right exists to operate against the will of the adult patient, even to save life. In an emergency, when the patient is not in condition to give consent and there is not time to communicate with those authorized to speak for him, without gravely jeopardizing his life or health, the law implies the consent of the patient.

A wife may determine whether or not she will be operated upon without her husband's consent.

In case of a girl under 18 years of age or a boy 21, the consent of the father is necessary; if he is dead, the mother's consent must be secured. Consent of other relatives, even if the child makes his home with them, will not suffice if the parents live. In grave and pressing emergencies exceptions to this rule exist.

Fees.—A corporation can be bound for an original engagement to treat an employee by promise of the president or general manager. A foreman, conductor, etc., has no authority.

Fees are impliedly to be paid by the patient if nothing is said upon the subject.

A person calling a physician to attend another is ordinarily not liable for fees.

One having a child in charge is not liable, from that fact alone, as in case of grandparents with whom the child lives. In such case the father may become liable even though he has no knowledge the service is rendered.

An original promise to pay fees, even if made by a stranger, is valid, if it is the basis for entry upon the case.

Joint Liability.—Joint liability exists for acts of a partner in the course of partnership business. Assistants in the direct employ of a physician create liability for their wrongful acts.

The family doctor who calls in a specialist with assent of the patient is not liable for the negligence or unskillfulness of the specialist.

The operator who has charge of an operation is responsible for it. One who assists him, as in clamping off blood vessels and sponging out, is not jointly liable for errors in performing the operation.

Assistants.—Acts of assistants under immediate supervision of the surgeon are his acts, in law; if in his employ, liability attaches for their acts within the scope of their duties.

Hospital attendants, internes and nurses, furnished as working facilities by hospital authorities, impose no liability on attending physician for their neglect, except as such acts:

1. Are directed by the physician.
2. Occur in his presence.
3. Are due to failure of the physician to give suitable directions.
4. The physician fails to correct careless or unskilled conduct of which he knows, or should know.

Contributory Negligence.—Contributory negligence of the patient may not bar his claim entirely. It depends upon whether his neglect to conform to instructions produces his entire infirmity or only a definable part of it. In the latter alternative it only lessens the amount of his recovery.

It is the general duty of a patient to follow reasonable instructions of the physician.

Consent, preferably in writing, must be secured before the hernia operation. Operation must not be undertaken on the side for which consent was not secured.

Local Anesthesia

Local anesthesia is of especial advantage in case an additional operation is found to be needed after the one for hernia is begun. For instance, when a hernia is discovered on the opposite side, after intraabdominal examination; when the appendix is found to be diseased; and when resection of the cord or testis is indicated.

Affidavit in Case of Atrophied Testicle

Claverley advised a routine examination of the testes previous to hernia operations. If the testicle on the side of the hernia is atrophied, the patient

should be required to sign an affidavit to that effect as a safeguard in case of litigation.

Injection Treatment of Hernia

The Supreme Court of Wisconsin stated that negligence in the course of a treatment may consist in the adoption of a wrong method of treatment, or it may consist in the negligent application of a proper treatment, and accordingly the court affirmed a judgment in favor of the plaintiff on the ground that the injection treatment of hernia was an improper method of treatment. (*Stenkowiczki vs. Lytle* [Wis.], 177 N. W. R. 849.)

Puncture by Surgeon of Artery Out of Place

The United States Circuit Court of Appeals, Second Circuit, affirmed a judgment in favor of the defendant who claimed that the accidental puncture of the deep epigastric artery during an operation for inguinal hernia was an accidental injury. The puncture in the deep epigastric artery was closed by suture. Sometime later the leg on the same side became gangrenous and had to be amputated. It was agreed that the gangrene was due to a blood clot forming at the site of injury to the deep epigastric artery and later occluding the femoral artery. (*Aetna Life Ins. Co. vs. Brand* [U. S.], 265 Federal R. C.)

Physician Must Treat Patients

The Supervisor of Industrial Insurance of the State of Washington has announced that under the provisions of the Industrial Insurance Act any physician is required to treat any injured workman applying to him for treatment who is protected by this act, and a refusal on the part of the physician to comply with the request will subject him to prosecution. In a communication from the Supervisor of Industrial Insurance, Mr. E. S. Gill, under date of April 4, 1923, writes: "I believe the medical profession of this state generally accepted the ruling enunciated in my brief as being correct, taking into consideration the fact that our law is a state monopoly, the state removing all rights of both employer and employee under the common law and placing them under the exclusive supervision of the industrial insurance law. I don't believe such a ruling would hold, however, in the states having what is generally known as the threefold plan in which there is state insurance, casualty insurance, or self-insurance permitted by the employers; but where the law is similar to that in this state I do not believe there is any question as to the duty and responsibility of the doctor under such a law."

Bibliography

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- BERGER, P.: Resultats de l'examen de dix mille observations de hernies recueillies à la consultation des bandages au bureau central du 4 février, 1881 au 14 août, 1884, Cong. franç., de chir. Proc. verb. [etc.], Par., 1885, lx, 89.
- CARSON, H. L.: The legal relations of the surgeon. *In*: Keen's surgery. Phila., W. B., Saunders, 1909, v, 1180-1197; 1913, vi, 1016-1017; 1921, viii, 905-909.
- CLAVERLEY, J. E. G.: The association of atrophy of the testicle and inguinal hernia. *Lancet*, Lond., 1917, i, 277.
- COLCORD, A. W.: Hernia. Should it be classed as a compensable injury or a disease? *Penn. M. J.*, Athens, 1917-1918, xxi, 672-684.
- COLEY, W. B., LEIGH, S., WALKER, J. B., HOPKINS, C. W., AND HUTCHISON, J. A.: Traumatic and industrial surgery. *Ann. Surg.*, Phila., 1922, lxxvi, 467-477.
- HOPKINS, C. W.: A study of traumatic hernia, so-called, among railway employees. *Internat. J. S.*, Burlington, Vt., 1921, xxxiv, 14-19.
- PLUMMER, S. C.: The relative importance of strain and anatomic predisposition in the causation of hernia. *Railway Surg. J.*, Chi., 1915, xxxvii, 307-316.
- SELBY, C. D.: Direct abdominal hernia of traumatic origin. *J. Am. M. Assn.*, Chi., 1906, xlvii, 1485.
- WAINWRIGHT, J. M.: The relation between oblique inguinal hernia and workmen's compensation laws. *Arch. Surg.*, Chi., 1923, vi, p. 605-637.
- WOODWARD, W. C.: Medico-legal relations of physician and patient. *Surg. Clinics of J. B. Murphy*, Phila., 1913, ii, 69-82.

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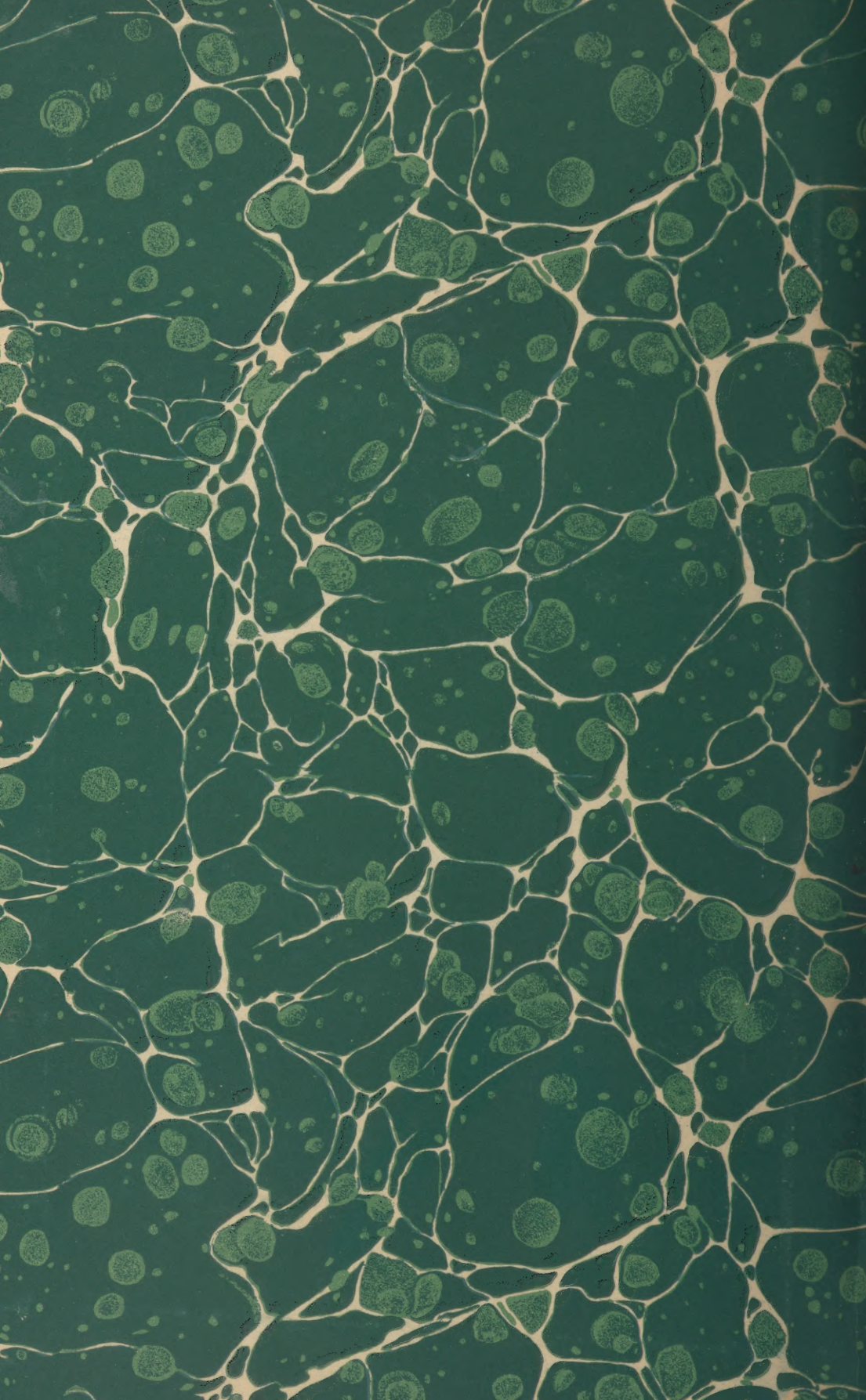
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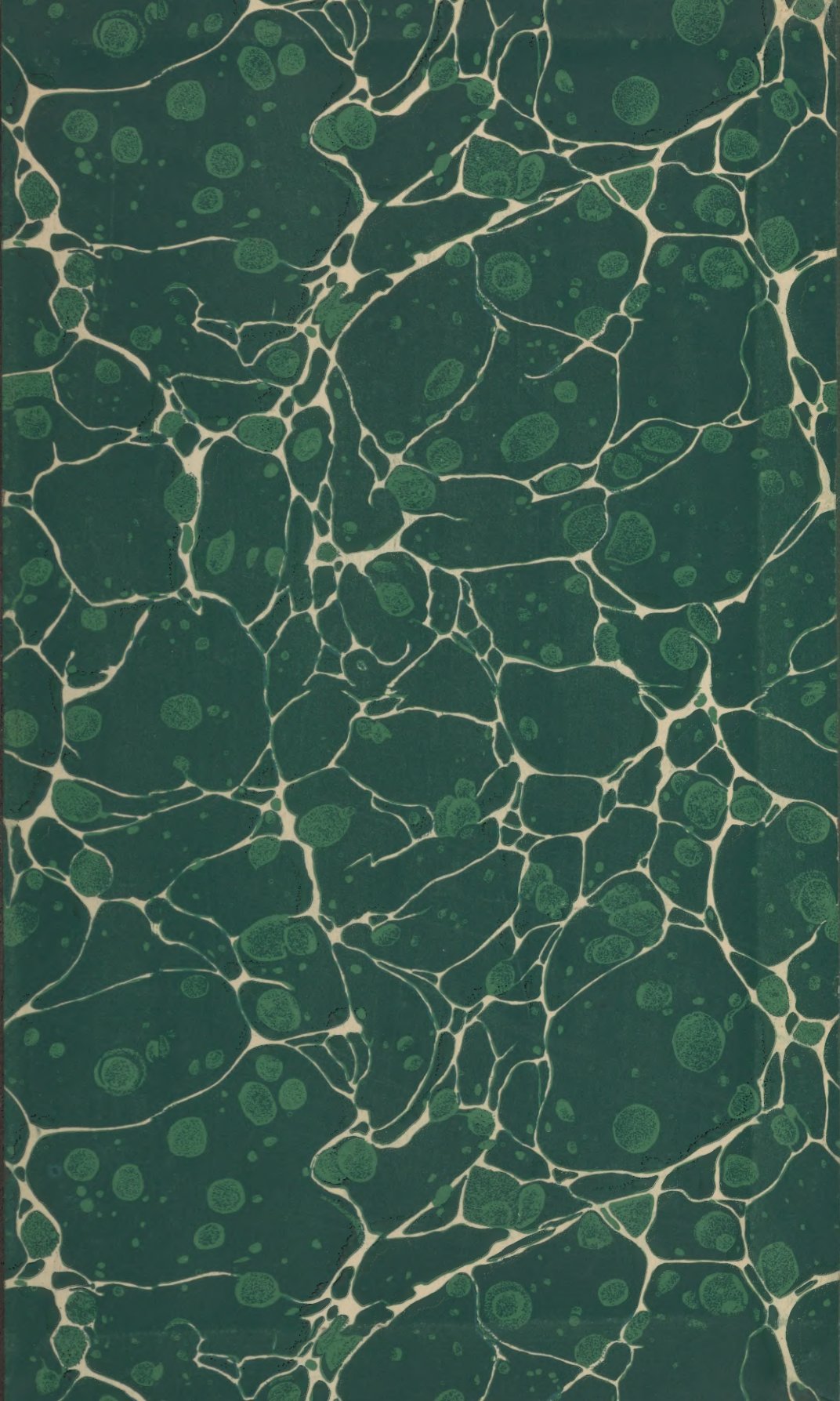
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